Background of California Water and Power Problems

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INTRODUCTION

THE IMPORTANCE of water and hydro-electric power in California and the accelerated rate of federal activity in water development here have created widespread interest in everything relating to these subjects. This interest is reflected in the news value attached to all events affecting our water supply. Floods or droughts receive liberal news space and issues of public policy receive widespread discussion.

This article attempts to present, in general but factually correct terms, information on the extent of the water resources of the state, the progress that has been made in their use, and the further developments that may be accomplished. Both the past control of the waters of the state and the prospective control are discussed.

The author is not an attorney. The comments here presented are the result of his own active work in this field as an engineer during the last 40 years. A look backward over the road we have traveled may aid in planning further progress.

California in 1848

The progress that has been made in California in the use of its water resources can best be realized by a comparison of present conditions with those prior to the coming of the forty-niners. The same water supply was then available but it was uncontrolled and unused. Large areas were made impassable by winter floods and even larger areas were unproductive during summer droughts. Minor navigation existed on the Sacramento and Colorado Rivers. The only constructed water systems were those serving the missions and small adjacent areas.

The change from the conditions in 1848 to those of a century later

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represents one of the greatest developments that has taken place in a similar period of time. It is not surprising that, in this growth, the rate of physical construction has exceeded the rate at which we have developed the governmental policies and the public agencies for the control of our water projects. Engineers have met the problems of design and construction, larger and larger sources of finances have become available, but a clear picture of the objectives the water projects are to serve and how such objectives can best be achieved is still lacking.

The Extent of California's Water Resources

Lengthy statistical material is available on the extent of the water resources of the state. Such detailed records are essential in the planning of water projects but only a summary is needed here to indicate the limits of the present and future use of our water supplies.

The mean annual measurable run-off from the 100,000,000 acres in California is about 80,000,000 acre feet. The mean annual precipitation is about 24 inches and the mean annual stream flow resulting from this precipitation is equivalent to a depth of run-off of 9.5 inches. In addition to the run-off from its own area, California has available an average of about 5,000,000 acre feet per year from streams rising outside of the state, principally the Colorado and Klamath Rivers.

The above broad averages need to be qualified before they can be understood. Run-off varies widely from year to year and in different parts of the state. Precipitation varies from less than 3 inches to nearly 100 inches per year and run-off from nothing to over 3 feet in depth per year. Twenty-five percent of the area of the state in the north Pacific and Sacramento River drainage area produces 65 percent of the state's water supply.

For the critical period of record from 1928 to 1934 the average annual run-off was less than one-half of the long time mean. This illustrates the principal problem involved in the use of the water supply. Not only is storage needed to control the run-off within single years to conform to the demand, but relatively large amounts of additional storage must be available if the excess supply of the above average years is to be retained for use in deficient years. It will never be possible to conserve all of the supply in the years of largest run-off.

1 An acre-foot is the amount of water which will cover one acre one foot in depth.
Conserving the last drop of the water supply is a worthy objective but is an objective which can never be fully attained.

The total present consumptive use of water in California is about 20,000,000 acre feet or about one-fourth of the mean annual run-off. This consumptive use is obtained about one-half from surface sources and one-half from percolating ground water.

California has large ground water resources. The material eroded from the steep mountainous areas has been deposited in deep porous valley fills which retain the slowly moving ground waters until they may be used. If ground water supplies are subjected to drafts which exceed the average rate of replenishment, gradual depletion of the accumulated supply occurs with pumping lifts eventually reaching the economic limit. Such overdrafts have occurred in many ground water areas in the state and some development has had to be abandoned. In other areas it has been possible to increase the natural ground water supply by spreading of local flood waters or by the importation of water from outside sources. Under present crop returns, ground waters are continuing to be used with increasing pumping lifts where abandonment would have occurred under the economic conditions of the 1930’s.

While California is generally fortunate in the quality of its water supply, in a few areas the original supply contains enough solubles to impair its use. In other areas the return waters may have become impure by their prior use. Salt water intrusion has begun to occur in limited coastal areas where the draft has resulted in lowering the local ground water below the sea level.

*Hydroelectric Power Resources*

The topographic and water supply conditions result in many favorable sites for hydroelectric power in California. It has been estimated that over 7,000,000 kilowatts of such power is physically available. Plants in operation or under construction are approaching one-half of this total. Fuel-electric power is also used extensively with the capacity in steam plants increasing proportionately more rapidly than that in hydroelectric plants.

A competitive limit is placed on the permissible cost of hydroelectric power by the cost of fuel-electric power. Fuel-electric power can be constructed in any amounts which the market demands. As the long trend of fuel costs is upward some water power projects not economical now may become feasible in the future.
In addition to hydroelectric power generated and used within California, power is now imported from the projects on the Colorado River, and, at times, to a limited extent from southern Oregon. In the future, additional power may be secured from projects which may be built on the Colorado River. Southern California represents the only major power market now in sight, within economic transmission distances, for the output of additional power projects in the lower Colorado River basin.

Development of power in California has been mainly by privately owned public utilities with public ownership where desired by the electorate. The economy resulting from serving diversified loads has resulted in the combination of the many early utility companies into a few large systems. The privately owned public utilities are subject to state regulation of both rates and service. The consumer owned public systems are illustrated in the municipal field by Los Angeles and Sacramento and in the irrigation field by Modesto, Turlock and Imperial Irrigation Districts. The first federal power in California was that of the Central Valley Project. Such power is entirely under the supervision of the Secretary of the Interior without state regulation.

**Future Importations of Water**

As this article is intended to be a discussion of the situation in California in the present and foreseeable future, it may be well at this point to mention the possibility of future water supplies from distant sources. As previously discussed, California is now utilizing only about 25 percent of its average water supply. Additional development of the state's water resources will be much more costly than those constructed to date, but such local developments will, in turn, be much less expensive than transporting water from far distant sources. Any plan for bringing water to California from the Columbia River should be deferred, even if it should ever be considered, until California has found means by which it can use the waters which still flow into the Pacific Ocean from within its own boundaries.

Another source of what may be regarded as an importation of water is the reclamation of sea water. Conversion of salt water can be accomplished by different known and workable processes insofar as the actual process of reclamation is involved. Here again the problem is economic. To date, there is no available process by which usable water can be produced from sea water on a large scale at a feasible cost. For coastal areas such a source of water supply would have
major usefulness. For inland areas, costs of conveyance would add economic limitations.

The water problems of California are immediate and pressing. No relief from such problems is in sight from distant or new sources. Consideration of the importation of water from far distant sources can be left to those who seek to secure publicity as prophets of the future or to those who prefer to concern themselves with matters far off in distance and time rather than to face and seek solution for current urgent local needs.

Land Resources

The lands in California include all variations. Of the total area of 100,000,000 acres only from 20 to 25 million acres are classified as suitable for cultivation of agricultural crops. The remainder includes forest and grazing lands, deserts and rocky wastes. The agricultural lands include the areas suitable for irrigation if water can be brought to the various areas at practicable cost.

The studies that have been made of the area of agricultural land for which a water supply may ultimately be made available in California indicate the limit may be from 10 to 12 million acres. This is about one-half of the total agricultural area of the state. The ultimate irrigated area may be distributed about 25 percent in the Sacramento Valley, 40 percent in the San Joaquin Valley, 10 percent in coastal southern California and the remainder in scattered areas.

The area irrigated, as reported by the 1940 census, was nearly 5,000,000 acres; at present this may have increased to 6,000,000 acres. This represents fully 50 percent of the probable ultimate irrigable area in the state.

WATER RIGHTS

Rights in Surface Waters

Water in arid areas is a principal form of real property and as such requires stable systems of title to its use. As water flowing in a stream at any time is lost if not taken by those entitled to its use, the titles to the use of water have to rest on different principles than those used for titles to the use of land. Conditions vary in different areas and the customs and laws governing the use of water also vary as each area has attempted to secure the system best adapted to its needs.

The early miners in California developed the appropriation system of water rights to meet their needs. Its principles were first expressed as rules voluntarily adopted and enforced by the mining camps. It
has continued to be used as it has been found to be well adapted to providing adequate security of right without permitting the abuse of holding such rights without use of the waters so acquired. Legislation relating to the title to the use of water was very limited until the passage of the State Water Commission Act in 1914. This Act changed the administration of rights to be acquired after its effective date from a county to a state basis and provided for definite procedure for the acquirement and administration of appropriation rights coming within its terms. In the passage of this Act, California was a follower rather than a leader as by 1914 nearly all of the other western states had similar legislation in successful operation.

While all of the customs relating to water developed in California have conformed to the appropriation system, the legislature adopted the English common law as the general rule for the state. In humid England a different system of title to the use of water had been developed. This consisted in assigning rights in the stream to the owners of the lands in contact with the stream. Such riparian owners had correlative rights as between each other and practically exclusive rights as against non-riparian owners.

With the use of water on non-riparian lands resting on appropriation and the adopted English common law placing control of water in the riparian owners, it was inevitable that conflicts should arise between these two systems. In the controlling case, *Lux v. Haggin*, the court upheld the riparian doctrine by a four to three decision. Having upheld the riparian doctrine, the rights so recognized became established and could not be taken without due process of law.

In 1926, the state supreme court went so far in *Herminghaus v. Southern California Edison Company* in upholding riparian usage of any kind against any extent of benefit by an appropriator, that public concern over the effects of this decision on the progress of the state brought about an equitable settlement of the conflict between these two classes of title to the use of water. The constitutional amendment of 1928 established the rule of reasonableness for all types of water use. This amendment has been construed by the state supreme court to require a riparian owner to show a reasonable character of use before he may enjoin an upper appropriator. This rule of reasonableness does not abrogate riparian rights but regulates their use in the public interest.

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2 69 Cal. 255, 10 Pac. 674 (1886).
3 200 Cal. 81, 252 Pac. 607 (1926).
There has never been any essential conflict in the public interest between the use of water on riparian or non-riparian lands. For otherwise equal conditions, each such use has equal public benefits. The opposition to the riparian doctrine, which finally forced its control, was the ability of riparian owners to prevent beneficial uses by others while maintaining wasteful uses themselves.

State Control of Water

In 1866 Congress recognized land and water titles acquired under local laws and customs. This legislation and its later supplements have been the basis for the control by the states of the acquisition of rights to the use of waters within the state.

Several federal statutes provide that various specified federal agencies, exercising proprietary functions of the Federal Government, shall acquire rights for their uses of water in accordance with state laws. Where the Federal Government is exercising its governmental functions, federal use may take precedence. However, the Flood Control Act of 1944 provides that consumptive uses of water in states wholly or partly west of the 98th meridian have preference over the use of water for navigation.

Rights to the Use of Ground Waters

The development of the basis of rights to the use of ground waters has also had a varied history. Use of such waters became important by the end of the last century. The state supreme court in 1903 defined the basis of title to be used in California. After full consideration, the court departed from the English common law rule giving complete control by an overlying owner of any water under his land and adopted a system of correlative rights. This decision with its applications in later cases has remained the rule in this state.

The establishment of legal principles governing rights in percolating waters has not prevented extensive and expensive litigation over such waters. This is largely the result of the difficulty in defining the amounts and the physical conditions under which such waters occur rather than uncertainty in the principles of title. Such difficulties are inherent in the nature of percolating waters.

The correlative doctrine relating to percolating waters was not materially changed by any later decisions until Pasadena v. Alhambra was decided in 1949. To meet the physical conditions in a basin which

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4 Katz v. Walkinshaw, 141 Cal. 116, 70 Pac. 663 (1903).
5 33 Cal. 2d 908, 207 P. 2d 17 (1949).
had been overdrawn for many years by both overlying owners and distant takers, the court accepted a principle of mutual prescription between all users. This basin is now being administered under the terms of the decision. It is too early to appraise the full effect of this addition to the correlative doctrine relating to percolating waters. Such appraisal will have to wait until the court has applied it to areas having varying physical conditions and different histories of use.

Administration of Water Rights

As soon as use of water from a stream approaches the amount of the available supply, a system of administration is required that each user may receive the water to which he is entitled at the time he has need for its use. Intrastate streams have been handled by administrative systems under state control. Interstate streams have been apportioned between states by interstate compacts or by adjudication in the federal courts with the administration within each state still generally under control of the state.

For surface streams, administration has not caused serious legal problems. A definition of the rights to be administered is a prerequisite to any control over diversions. The administrative officers, usually called water masters or commissioners, have no judicial powers to define rights. Once the rights are defined, the problems of operation are mainly those of adequate water measurement, allowances for stream losses or gains and other physical items.

In California, the irrigation streams usually have a short course across the main valleys. Diversions have been made on many streams by means of a limited number of individual canal systems. This has simplified the administrative problems as a whole so that it has been found essential to have water master service with fewer streams than has been the case in other western states. Riparian rights are less easily administered as the extent of the right is relative rather than specific. The construction of storage usually results in a need for stream supervision as stored water commingled in a natural water course is not subject to the acquired rights in the direct flow.

Few states have attempted to administer rights to percolating ground waters. In some areas, public interest has required that such administration be attempted. New Mexico has successfully applied control in defined artesian basins. The need for regulation of percolating waters is increasing and extension of such control can be expected. The lag in the regulation of ground water relative to the regulation of use from surface streams is the result of the recognition of
the greater difficulty in defining the point at which ground water draft equals the supply so that limitations are required. The problems of ground water administration are as much the result of such physical conditions as they are of any lack of legal procedures for such regulation.

LOCAL ORGANIZATION AND FINANCING OF IRRIGATION DEVELOPMENT

Like matters of water rights, early organization and financing of irrigation development caused few policy problems. Projects beyond the capacity of individuals were constructed by cooperative companies or private contract companies. Both of these forms of organization have been used extensively in California. The cooperative or mutual water company is still a dominant type in southern California. Many of the contract companies became public utilities. In recent years many utility irrigation systems have been acquired and are now operated by the landowners served.

California passed its first Irrigation District Act in 1887. Later state approval of district organization and financing was required. This form of organization had a very important part in the expansion of irrigation in California prior to 1930. It is still a major method used for operation although it has been superseded for construction of new projects because of the more liberal terms on which federal funds are now available.

About $100,000,000 of bonds of nearly 100 California irrigation districts were sold prior to 1930. By 1932 these districts had collected and paid, in principal and interest, $76,000,000 on these bonds. This amount was nearly twice the amount collected to the same date by the Federal Bureau of Reclamation on a construction cost in all of the western states of over $200,000,000. During the depression of the 1930's about 75 percent of the outstanding California irrigation district bonds were refinanced through the Reconstruction Finance Corporation with an average loss to the bondholders of about one-half of their investment. The refinanced districts have maintained a good payment record since their refinancing.

Until the 1920's irrigation development in California had been mainly by local projects using direct stream flow. Storage was becoming necessary on some streams and opportunities for power development at the reservoirs were in prospect. Some California irrigation districts constructed storage prior to 1930 and used the returns from
the power obtained at the dams to aid in meeting their irrigation costs. These projects were the beginning of the multiple purpose stage of California's water development.

THE FEDERAL GOVERNMENT IN WATER DEVELOPMENT

Irrigation

The Federal Government's interest in its lands has been that of a proprietor seeking to dispose of or to retain such lands in accordance with the public interest. As public interest has varied over the years, federal policies have changed. In early years when there was a surplus of public land and a deficiency in settlement, liberal disposal policies were followed. As population has increased and public lands decreased, disposition of lands has been placed under increasingly restrictive terms.

To meet the conditions on arid lands, Congress passed the Desert Land Act in 1877. This Act required the irrigation of the entry as the basis for securing the patent. The enlarged Homestead Act in 1909 sought to meet the needs of dry-farm areas. These were all individual forms of entry to be improved by the settlers with their own finances.

By the late eighties outside financing for larger units had become necessary and eastern private capital entered the irrigation field in some western states. In California such financial needs arose earlier and were met more largely from local sources.

By 1902 western pressure secured the passage of the Reclamation Act, providing for construction of irrigation projects with federal funds. Costs of federal projects were to be repaid by the owners of the lands to be served. No capital grant to these owners was intended although a subsidy has always been present, as from the beginning no interest has been charged on the capital advanced. It was expected that these projects would serve mainly public lands. For public lands the general homestead terms, such as the 160 acre limitation on the size of ownership, residence and improvements, were required. It was soon found that the best projects consisted largely of private lands. Public lands have been the major area in some projects but as early as 1908 construction was started on the Orland project although it had practically no public land. This was the only federal project entirely in California until the Central Valley Project was undertaken in 1935.

Direct appropriation for the federal irrigation projects was avoided in the original Reclamation Act by assigning to the reclama-
tion service the net returns of the Federal Land Office. In the earlier years such funds averaged about six million dollars per year and set the scale at which construction could progress. Except for limited loans of special funds, the only funds available to the Bureau of Reclamation prior to 1932 were the assigned sources of revenue from public lands. Part of the royalties from oil on public lands were included. In the first thirty years of its operation the total accretions to the reclamation fund were $154,000,000.

About thirty projects were undertaken prior to 1930. The first projects came into operation between 1905 and 1910 and by 1914 repayment difficulties had become severe. The original act required repayment of construction costs in ten years. Costs of the earlier projects were generally higher than had been expected when the Reclamation Act was passed. The costs of the necessary improvements on his land consumed the settler's initial capital and his crop earnings did not meet his water costs. In 1914 Congress extended the time of repayment to twenty years and in 1924 to forty years. In 1939 an additional ten year initial development period was authorized. As the entire repayment period has been without interest charges on the unpaid costs, these extensions in time of payment have represented increasing costs to the Federal Government.

In the forty-eight years of operation the Federal Government has spent two billion dollars on reclamation bureau projects. Little information on collections is now published. Collections have been reduced by extensions in the length of time of repayment contracts and by special moratoria granted by Congress. In the forty-eight years of activity the reclamation fund for the projects started prior to 1932 has revolved less than once. The projects begun during the depression or later, which have been financed by direct appropriations from the federal treasury, are still mainly under construction and their repayment history to date is not a measure of what may be collected.

The earlier federal projects irrigated new lands. In the 1920's the emphasis was placed on projects to provide supplemental water to areas already under irrigation. Early in its experience the Bureau of Reclamation learned the advantages of transferring the operation and maintenance of the completed projects to local management. Irrigation districts comprising the lands to be served were usually formed for this purpose. The Bureau reserved only the extent of general supervision of such local operation needed to protect the federal investment.
As early as 1920, opportunities for local single purpose projects were becoming limited and interest turned to broader types of development. This was reflected in California in the investigations by the state of a plan for ultimate water development and by the activities in southern California resulting in the construction of Hoover Dam. Such comprehensive plans provide multiple uses of water. The combined repayment capacity of multiple use projects may be sufficient to meet the total project costs.

Power development was included as a by-product in some of the earlier federal irrigation projects. With their higher dams on main streams, the power features have become major items in recent projects. The western demand for power has increased concurrently with the increase in potential power output from federal irrigation projects. The cost per acre served of recent projects has usually exceeded the charges landowners are able to pay so that income from other project features is required to enable the full costs to be met. Power has changed from a secondary feature in the earlier projects to a dominant element in the feasibility of comprehensive projects such as the Columbia Basin and the Central Valley.

These changes in types of projects would have come about even without the extensive public work relief programs of the 1930's. The availability of such funds served to enable such projects to be undertaken at an earlier date than might have otherwise been the case. These relief projects also accustomed the public to scales of public expenditures beyond previous experience and made the appropriations required less of a shock to the public thinking.

Flood Control

Concurrently with the expansion in its program in irrigation and power development, the Federal Government has expanded its participation in flood control. This expansion has been accompanied by a reduction in the extent of the required local contribution. The local participation has been reduced to the costs of rights-of-way and obligation for future maintenance for channel improvements and has been eliminated for storage projects.

The present federal flood control policies are the result of conditions and influences in the eastern and middle western states. Being national in scope, such policies are also applicable to the western states.

California has major flood problems in the trough lands of the
Central Valley. Large local expenditures had been made in these areas before federal participation became available. Since 1936 further flood control in California has been a federal function under the terms of the present policies.

Following federal authorization of a group of California flood control projects in 1944, the California Legislature in 1945 gave state authorization to the same projects and appropriated state funds to meet the local costs. To administer the state's functions in the projects, the legislature provided for a State Water Resources Board.

Other Water Uses in Multiple Purpose Projects

Irrigation, power and flood control are the principal uses of multiple purpose projects. Such projects also have various by-products which have individual repayment policies. For some of these other uses the costs are not charged to their direct beneficiaries. The term "non-reimbursable" is in general used for costs met by the Federal Government. All costs are necessarily payable from some sources; the "non-reimbursable" costs in federal projects are paid by the federal taxpayers.

Navigation is a federal function; expenditures for its improvement are not charged to the users of navigation works.

Protection of fish and wild life is a major item of interest to those concerned with this type of recreation. For fishing, commercial values are, at times, involved. Costs allocated to these purposes were made non-reimbursable in 1946.

Recreation values frequently are created by works built for other uses of water. To justify the ever increasing costs of the remaining projects, it is now being urged that the recreational benefits should be estimated and included in determining project benefits and that costs allocated to recreation should be non-reimbursable.

Expenditures for municipal water supply in Bureau of Reclamation projects were authorized in 1939. Interest charges on the unpaid principal rest in the discretion of the Secretary of the Interior. Variable practices have been followed in individual projects. The principal cost is to be repaid in forty years.

An additional justification for federal construction of projects may be their usefulness in national defense. The availability of the power developed in some projects constructed prior to World War II was a major factor in the location of certain war industries.
Standards of Feasibility

By standards of feasibility is meant the ratio of the benefits produced by a product to the costs of producing such benefits. To be feasible the benefit cost ratio must exceed unity. The present public support for construction of water projects by the Federal Government can be expected to result in a continued large federal appropriation for such projects. To what extent can the expenditure of such funds be limited to those projects where the federal benefits exceed the federal costs? Can benefits be defined with sufficient definiteness to furnish a sound basis for project selection?

There has been constant pressure to lower the standards of feasibility as the costs of the remaining projects have increased. This has resulted in bringing a continuous list of marginal projects within the standards of feasibility required for construction. It has now reached the point where projects are being proposed regardless of their cost. When, as in the Bureau proposed Mt. Hone project in Idaho, authorization is sought for construction which will cost about $1,000 per acre for land reported to have a value of $100 per acre with water, standards of feasibility have been reduced to a requirement that while figures of cost and benefit must be assembled they are not required to have any practical relationship to each other.

Subsidizing of irrigation development at an increasing rate has now been a practice for nearly fifty years. Some subsidy can be justified by the indirect benefits resulting from new developments. The direct benefits are tangibly measured in the increase in land value before and after water is provided. The indirect federal benefits that may result from the irrigation of a new acre of land do not exceed the similar benefits that would result from the same production on some other acre elsewhere. The Federal Government cannot justify a subsidy to irrigation which exceeds the cost of alternate forms of securing similar results. There is much support for a conclusion that present subsidies exceed such alternates.

Colorado River Development

A multiple purpose project of major importance to California is Hoover Dam on the Colorado River. Its history and its problems are

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6 Direct benefits are those which can be defined and measured; for irrigation the direct benefits are those accruing to the landowners served. Additional benefits such as community growth or increased value of products in the channels of trade are not subject to tangible measurement; for such items the term indirect benefits has generally been used.
too lengthy and too involved for more than a general summary to be attempted here.

The Imperial Valley had proceeded with its own use of Colorado River water until it became faced with problems beyond its capacity to handle. These problems included the danger that flood waters would again break into the Valley as they had in 1905, the need for storage regulation for irrigation, and the international complications resulting from having a portion of their system in Mexico. A physical remedy was available by means of storage at Boulder Canyon. This required a dam exceeding in height any previously built and costs beyond the means of the local area.

The Colorado River is an interstate stream. Its flow has been divided among the seven states concerned by an interstate compact.

As the proposed dam was located outside of California, its construction by a state agency was not practicable on legal grounds and the project was necessarily and properly a federal undertaking. Efforts to secure its construction finally succeeded, the project was built and has been in successful operation since 1936.

The Hoover Dam was a pre-depression project and serves to contrast policies then and now. Of the federal investment in the Boulder Canyon Project of over $150,000,000 all, except $25,000,000 for flood control, is being repaid in full with interest. Power will be the dominant source of such repayment. Before construction started, firm contracts for power sales which would meet such payments were secured. Delivery of such power to the purchasers is made at Hoover Dam. The only construction to which reclamation law terms of repayment were applicable was the All-American Canal which was constructed to place the entire canal system of the Imperial Valley within the United States. The Metropolitan Water District of Southern California has constructed its own aqueduct with District bond funds to convey Colorado River water to the coastal area of southern California. In the All-American Canal the Bureau of Reclamation has not attempted to revise the economy of the established Imperial Valley by the enforcement of acreage control on the size of farms. For the extension of the All-American Canal to the new lands of the Coachella Valley the 160 acre limitation of the general reclamation law is applicable. The investment made in southern California with locally provided interest bearing funds for power and water transmission has been about three times the federal investment in Hoover Dam. Interest on the cost of Hoover Dam as it is earned is actually being paid
into the federal treasury instead of being diverted to other uses as is now being done on reclamation act projects.

THE CENTRAL VALLEY PROJECT

The Present Project

Not only is the Central Valley Project of major interest to a large part of the state, but it includes practically all types of water use and illustrates almost all of the physical, economic, social and administrative conditions that will be found in any of the comprehensive projects. Its principal incentive was to provide an irrigation supply for a large area which was overdraining its ground water supply. To secure such water required construction costs in excess of the ability to pay of the lands to be served. The works required included storage which would make available an attractive power opportunity which could assist in meeting the irrigation cost deficit. There were flood control, navigation, salt water repulsion, municipal water supply and recreational benefits. The project would affect fishing with much contention over whether such net effects would be a detriment or a benefit. Being stretched from the northern part of the Sacramento Valley to the southern end of the San Joaquin Valley, its geographical scope alone would prevent its development by any agency below a state or federal level. Being entirely within California it was free of any interstate problems. Both as a means of rescuing an area approaching possible abandonment and in the boldness of its plan the Central Valley Project caught and has maintained an active public interest in all of its features, both within and without the actual project service area.

The development of the plan of the Central Valley Project proceeded through the 1920’s and became ready for action at the beginning of the depression of the 1930’s. It had been hoped that it could be financed on a local or state level but the conditions in the 1930’s made this impracticable. Looking backward, it does not appear now that the state’s plan for financing on an interest bearing revenue bond basis would have been successful under any conditions.

The situation was ideal for the entrance of the Federal Government in 1935. Federal funds had been granted to the President free from the restraints of congressional consideration and authorization applicable to the selection of projects. Such an executive allotment was secured and the project started. This start was soon followed by congressional authorization and appropriations. The Federal Govern-
ment was committed to the construction of the project and the state was committed to the acceptance of these funds with the federal control over the project which went with this acceptance.

The original estimated cost of the present Central Valley Project was $170,000,000. The present expected actual cost exceeds $440,000,000.

The Ultimate Project

Both state and federal agencies have explored the ultimate development of water in the Central Valley and have outlined plans for its accomplishment. While no one has the vision to predict the particular form such development may take in the next fifty years, these studies enable the scope of possible ultimate use to be outlined.

The state plan for ultimate development in the Central Valley included about 18,000,000 acre feet of surface storage capacity in 24 reservoirs. The total cost was estimated in 1930 as $684,000,000. A water supply for nearly 8,000,000 acres would be made available. Power plants with 1,730,000 kilowatts of installed capacity would be constructed. This plan is now being restudied and brought to date by the State Water Resources Board.

The comprehensive plan for the Central Valley Basin of the Bureau of Reclamation would provide supplemental water to about 2,000,000 acres now irrigated and a full supply to 3,000,000 acres now dry. An installed capacity of 1,700,000 kilowatts of hydroelectric and 750,000 kilowatts of fuel-electric power would produce eight billion kilowatt hours per year of energy. Constructed reservoirs would have a total capacity of 30,000,000 acre feet. This would be supplemented by 20,000,000 acre feet of ground water storage. The total estimated cost, based on the 1940 cost level, was $1,810,000,000. The annual costs were estimated to be $99,730,000 and the annual benefits $275,003,000, giving a claimed ratio of benefits to cost of 2.7 to 1.0. The benefits derived include direct, indirect and intangible items. Of the total cost it was estimated $210,000,000 would be charged to flood control and navigation (non-reimbursable), $770,000,000 would be repaid by irrigation, municipal and miscellaneous water users, and $830,000,000 would be repaid by sale of commercial power. Neither of these repayable items would return interest to the federal treasury during the period of repayment under Bureau accounting.

The ultimate development of the Central Valley will be superimposed on the present projects. In the Sacramento Valley there has been less irrigation in the past and further units will not need to meet
as complex present systems as in the San Joaquin Valley. The future systems in the Sacramento Valley will run in the direction of present systems in the usual downstream type of diversion. In the San Joaquin Valley additional water will have to be imported from the Sacramento Valley. Such imported water will be conveyed against the grade of the San Joaquin Valley and the present use of the San Joaquin Valley streams.

Repayment of Costs of the Present Project

Even under the original estimates, it is doubtful if the irrigation users of the present Central Valley Project could have met the charges on costs properly allocated to irrigation. It is recognized that the ability to pay for irrigation service represents only a relatively small margin over the project operation expenses. Costs of operation are necessarily high as the result of a 200 foot pumping lift and long distances of conveyance.

These conditions raise the question of the extent to which other project services are capable of meeting the irrigation deficit and how far it is equitable to require other services to meet costs in excess of their own cost of service. The two project services whose ability to pay exceeds the costs properly chargeable to their own service are power and municipal supply.

In 1946 the then estimated cost was allocated to the various project services as shown in the following table. The table also shows the amounts of repayment each service was expected to make over the first sixty years of operation. The repayment schedule as set up by the Bureau of Reclamation in 1946 would require a repayment period in excess of that authorized by law at present. Since 1946 the estimated costs have increased about 15 percent; this will result in a proportionate increase in the period of repayment.

<table>
<thead>
<tr>
<th>Item</th>
<th>Total estimated cost</th>
<th>Allocated repayment of cost</th>
<th>Cost in per cent of allocated repayment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-reimbursable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Navigation</td>
<td>$18,083,000</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>Flood Control</td>
<td>31,444,000</td>
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<td></td>
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<tr>
<td>Reimbursable</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Irrigation</td>
<td>221,551,600</td>
<td>58,545,475</td>
<td>35†</td>
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<tr>
<td>Municipal and Industrial</td>
<td>9,091,800</td>
<td>29,667,932</td>
<td>327</td>
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<tr>
<td>Power</td>
<td>104,143,600</td>
<td>227,757,693</td>
<td>218</td>
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<tr>
<td>Deferred Irrigation</td>
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<td>18,815,900</td>
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<tr>
<td>Total Allocation</td>
<td>$384,314,000</td>
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<td></td>
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<tr>
<td>Total Reimbursable</td>
<td>334,787,000</td>
<td>334,787,000</td>
<td>100</td>
</tr>
</tbody>
</table>

†Total irrigation repayment, including deferred costs.

8 Costs incurred in present project for future usefulness.
In its repayment schedules, the Bureau charged interest each year on the unpaid balances of costs charged to power and municipal supply. The rates at which it is planned to sell power and municipal water are made high enough to earn such interest. However, the interest so earned is not to be paid into the federal treasury to compensate the government for the cost of providing the capital for construction of the works used for power and municipal purposes but is to be diverted to meet the deficit in principal repayment on the construction costs assigned to irrigation. This method of accounting is based on the interpretation of the 1939 Reclamation Repayment Act by the solicitor of the Department of the Interior. The interpretation rests on finely drawn construction of wording in the Act and is in conflict with earlier Bureau interpretations.

The method of deriving repayment ability equal to the costs used by the Bureau is equivalent to the Federal Government providing interest free capital over the repayment period not only for irrigation but also for power and for municipal use. As the Federal Government has not authorized the construction of single purpose projects on an interest free repayment basis for either power or municipal use, it would seem that this burden should not be placed on the general taxpayers for such uses in multiple purpose projects involving irrigation.

The frequent claim that power is being used to carry irrigation costs is a part truth that tends to obscure the facts. Power rates are not to be made high enough to produce revenue in excess of power costs to repay irrigation deficits. Power is to be sold at a price which will meet interest on its unrepaid capital costs, as required by law, but the interest so earned is to be diverted to other accounts instead of being paid into the general treasury as reimbursement for actual interest cost of the capital advanced for the power features of the project. Actually it is the general taxpayer who will not only subsidize the irrigators in the project by providing interest free capital for irrigation cost but will, in addition, provide interest free capital for power for the full repayment period of the entire project in order that the interest actually earned on power costs may be diverted to other uses.

*Future Operating Agency*

Past developments have been successfully operated by local organizations with diversions from the streams administered by the state. When a project extends over such an area as the Central Valley, the same conditions apply to its various parts but the size alone
requires changes in the type of local operating organization. It is necessary that the organization have a governing board representative of its various parts but the basis for the selection of the members of the board requires different procedures. The need for some inclusive form of organization is generally recognized but agreement on its particular type is still lacking. An effective locally controlled operating agency should be found somewhere between present local districts and distantly appointed and controlled administration of the TVA type.

Adequate experience is available in similar situations where the size of project and the diversity of interest has made the election of a board of directors cumbersome and involved. Under the State Reclamation Act, the governor appoints the members of the board of the Sacramento-San Joaquin Drainage District. In some other areas, special acts make the county board of supervisors the board of directors of countywide districts. In some cases the directors may be appointed by the judge of the local court. In such projects incurrence of major indebtedness is dependent upon a favorable vote of the electors responsible for its payment.

As the Central Valley Project covers a large part of the state, a state board might be established for its management. A state board should have a membership representative of all parts of the state; the central valley would want all members of its governing board selected from its own area. There are precedents for state regional boards, as in the recently enacted Water Pollution Acts, and a similar practice could be used for the Project.

An alternate to state agency operation of the Central Valley Project is its continued operation by the Bureau of Reclamation. This would give the minimum of local control and the maximum conflict between state and federal agencies. The Project is already the basis for a conflict between local and federal control in the contracts with local units. Contracts for project water place almost the entire policy control in the discretion of the Secretary of the Interior. The effect of the Project on the valley will be so extensive that the control of its policies and service could dominate the economy and consequently the politics of its area. Unless such a project is locally controlled, its operation would represent a form of federal government outside of our past experience.

Out of these uncertainties and conflicts in interest a few items can be accepted. These include the existence of the present project as now
under construction and its eventual expansion to include other projects in the Valley for both irrigation and power. Large size and complexity are inherent in the present and any future development. The difficulties resulting from size cannot be avoided; the project is here and will remain.

A second conclusion which past experience supports is that the nearer control can be placed to the users of the project, the more acceptable will its operation be to these users. Greater economy in operation has also resulted from local control. The principle of local control should be accepted and efforts directed toward working out its best form. Any differences that may arise in regard to the best form of local control do not justify seeking refuge in the acceptance of permanent distant administration with local users deprived of adequate representation in the management of their own service.

For the present Central Valley Project the natural time for transfer to local operation will be the completion of the main features of the initial project and the beginning of its full operation. If the Project is to be expanded indefinitely by the addition from time to time of other units, the transfer of each unit can be made when it is ready for operation.

A main item in the transfer of operation would be the character and extent of the repayment obligation assumed by the local agency. This item is largely in process of settlement now as the repayment pattern is being established by the contracts being made with the units to receive local service. The overall local agency can and should assume responsibility for the administration of contracts with individual local units. This will secure to the Federal Government the same repayment it would be able to secure under its own administration. No overall local agency should be expected to underwrite the project costs on any better basis than the Bureau of Reclamation is now accepting from individual project units.

The Project as a Basis for Economic Controls

The undertaking of an irrigation project by the Federal Government is an entirely voluntary act. Consequently the government can set any terms it may choose as conditions on which it will construct such a project. This authority has not been questioned. Arguments relating to the exercise of this authority concern the extent to which any terms prescribed by the Federal Government may represent desirable public policy.

It has always been the practice that those providing funds for a
project exercise some measure of control. In any loan, conditions are imposed to protect the security. As the Federal Government supplies the capital cost of the projects it builds, there has been little complaint of requirements made to assure the security of the loan and the proper maintenance of the properties.

Private sources of funds generally have not exceeded the controls needed for the security of their loans. The Federal Government has used its control of the funds for construction of projects to go beyond the protection of loans and to attempt to enforce economic controls unrelated to the value of the security. The most widely publicized item in such economic controls is the 160 acreage limitation. This is an attempt to limit the size of farms although it has been admitted that larger units may be more profitable and consequently better able to repay irrigation charges.

On projects completed during periods of active land demand it has been to the advantage of large landowners to sell their excess acreage and this has generally been done without enforcement of the acreage limitation provisions. As most purchasers did not desire or could not finance more than 160 acres, it was not necessary to force acreage control in such projects. Where the demand for new lands has not resulted in voluntary subdivision of large holdings, there has been no effective enforcement in fact.

In the Central Valley Project, the availability of ground water in the greater part of the area to be served makes enforcement of acreage control by refusal to deliver surface supplies impracticable. This was recognized by all except the Bureau of Reclamation from the start. It has finally been recognized by the Bureau and the present terms of the contracts being made, while retaining the 160 acre limitation clauses, practically eliminate enforcement.

**Forms of Repayment Contracts**

There has been extended discussion of the so-called 9d and 9e repayment contracts. Much of this discussion has been more confusing than helpful. Until 1939 repayment contracts for construction costs specified the amounts to be repaid and the terms of repayment. When the terms of such contracts had been met, the contracting unit had a completely paid for property and a continuing right to the use of water. This form of contract was carried into the 1939 Reclamation Repayment Act in Section 9d and has come to be known by this designation.
The 1939 act also authorized a forty-year water rental type of contract in Section 9e. Under such contracts the unit secures a term contract for water service at an annual rate. Earlier contracts offered no right of renewal although it is proposed to modify this in later contracts. Under the 9e contract the Bureau of Reclamation becomes a public utility selling service instead of a construction agency selling constructed projects to their users.

The Bureau is using 9e contracts for the sale of water from the Friant-Kern Canal and 9d contracts for the construction of distribution systems for the local units. Such units have generally objected to the 9e contract but are signing them as they represent the only basis on which they have been able to secure the water they require.

If the Federal Government would accept the full obligations of a public utility, there would be much less reason to oppose the 9e contracts. Such obligations include administrative control of rates and service, a responsibility for continued adequate service and a right on the part of the consumer to receive service as long as he meets the terms of service. The 9e contracts reserve discretionary control to the Secretary of the Interior. The contracting unit has no defined division of its payments between operating costs and repayment of construction costs. The Bureau can set the rates to return operating costs only and thus, by administrative action, extend indefinitely the time during which the Federal Government furnishes construction costs on an interest free basis.

Further legislation is needed to define and limit the conditions under which the 9e contract may be used. If complex projects having costs chargeable to irrigation which exceed the ability of the irrigator to pay are to be built, a proper type of 9e contract can be designed to meet the interests of both the user and the Federal Government.

GENERAL COMMENTS

The entrance of the Federal Government into the construction of irrigation projects stimulated other activities in this field. The first decade of the Reclamation Act was the most active in all types of irrigation development of any in our history. Federal construction did not restrict other forms of development until the later 1920's when the increased subsidization made available for federal projects made competition more difficult. The slowing down and eventually the practical ending of interest paying irrigation development would have occurred without federal competition as the costs of the remaining
single purpose projects were becoming greater than could be met at market rates for funds.

This shutting off of private irrigation development has given the federal agencies a practical monopoly of the construction of further irrigation works. This, in turn, has made local areas, and even entire western states, dependent on the availability of federal funds if the development of their water resources is to proceed. This dependency has affected the normal relationship of the state and federal governments. The ambitions and desires of the states to secure projects has made them willing to accept control by the Federal Government of functions of the states in the field of water use.

In the first thirty years of its existence, the Bureau of Reclamation was a constructing agency carrying out the terms of legislation passed by Congress and spending the appropriations from the reclamation fund in accordance with the directions of Congress. The scale of activity was limited by the accretions to the reclamation fund as Congress had not provided direct access to the federal treasury for Reclamation Act projects. In this period the Bureau established a very high standing for the quality of its engineering work and the economy of its operations. The Bureau was a service agency administering the reclamation law. It did not assume to control legislation nor make judicial decisions in regard to the law. When repayment difficulties arose, Congress, from time to time, set up special commissions from outside the Bureau to review its status and to recommend changes in the Reclamation Act. Legal controversies reaching the courts were considered on the then current precedents relating to the functions of the federal and state governments.

The change in the source of its funds and the expansion in its scale of activities in the 1930's has altered the entire status of the Bureau. Access directly to the federal treasury for construction funds has created an incentive to the promotion of an increased scale of operations on the part of the Bureau. Appropriations for recent single years have exceeded the total expenditures by the Bureau in the first thirty years of its work. This enlarged scale of activity has made the Bureau a dominant factor in the West. Prior to this era the directing positions in the Bureau were generally filled by the promotion of those having experience in its work. In the few instances in which appointments not meeting this standard were made corrections were secured relatively quickly. These standards have not always been followed in recent years and the corrective efforts of Congress have been unsuccessful.
Those directing the present Bureau have assumed activities in relation to legislative matters that were formerly the function of Congress. Proposed legislation emanating from the Bureau has been drafted to meet Bureau desires for expansion. Local desires for federal funds are used to secure support for liberalization of repayment terms and increased appropriations. Local opposition to increased federal control is weakened by the fear of the western states that appropriations for projects in their area will be reduced. The present situation represents an extent of federal domination in the field of western water development that the original supporters of the passage of the Reclamation Act could not have visualized.

This article started with a brief comment on conditions in California in 1848. If the hardy pioneers of that era could return to California now, the changes could not help but be startling to them. In time they could come to understand the physical development that has occurred as they were equally resourceful within their means in accomplishing similar results. These pioneers would have their greatest difficulties in understanding the governmental restrictions and controls that have been accepted in recent years. It would be too much to expect for them to adjust themselves to present limitations.

It would be helpful if the present generation would look backward and try to determine how much of the expansion in the present economic and social controls has been the necessary result of population congestion and technological changes and how much has been the result of the ambitions of those in public employment who seek to rule rather than to serve. In any such study the record of the Bureau of Reclamation over the forty-eight years of its operations would make a most interesting and enlightening case history.