



1929

## Economic aspects of the Boulder Canyon Project

Leonard McKaig  
*University of the Pacific*

Follow this and additional works at: [https://scholarlycommons.pacific.edu/uop\\_etds](https://scholarlycommons.pacific.edu/uop_etds)

 Part of the [Agricultural and Resource Economics Commons](#), [Environmental Studies Commons](#), [Geography Commons](#), [Labor Economics Commons](#), [Labor History Commons](#), [Political Economy Commons](#), [Public Affairs, Public Policy and Public Administration Commons](#), [Public Economics Commons](#), [Public History Commons](#), [Regional Economics Commons](#), [Social History Commons](#), [United States History Commons](#), and the [Work, Economy and Organizations Commons](#)

---

### Recommended Citation

McKaig, Leonard. (1929). *Economic aspects of the Boulder Canyon Project*. University of the Pacific, Thesis. [https://scholarlycommons.pacific.edu/uop\\_etds/890](https://scholarlycommons.pacific.edu/uop_etds/890)

This Thesis is brought to you for free and open access by the Graduate School at Scholarly Commons. It has been accepted for inclusion in University of the Pacific Theses and Dissertations by an authorized administrator of Scholarly Commons. For more information, please contact [mgibney@pacific.edu](mailto:mgibney@pacific.edu).

ECONOMIC ASPECTS

of the

BOULDER CANYON PROJECT

---

A Thesis

Presented to the Department of Economics

College of the Pacific

---

In partial fulfillment

of the

Requirements for the  
Degree of Master of Arts

---

By

Leonard McKaig

May 25, 1929

## CONTENTS

Chapter	Page
Introduction	
I. Early History of the Colorado River.....	1
Period of Exploration and Investi- gation 1536-1900.	
II. Modern History of Colorado River and its Development.....	10
Investigation and reports	
The Kincaid Act.	
The Swing-Johnson Bill	
The Colorado River Compact	
The Boulder Canyon Project Act	
III. Physical Features of the Colorado River Basin.....	15
Physiography	
Silt	
IV. The Problem of Flood Control.....	22
Imperial Valley and the disaster of 1905-1906	
The Silt problem and other floods	
Levee construction	
Reality of the problem and its solution	

## CONTENTS

Chapter	Page
V. Irrigation and the All-American Canal.....	31
History of irrigation development and present status	
Silt in its relation to irrigation	
International problem	
Reclamation of arid land	
The All-American Canal	
Engineering feasibility	
Economic justifiability	
VI. Domestic Water Supply.....	56
The need	
The proposed aqueduct	
The metropolitan water district	
Economic advantages	
VII. Power Development.....	65
Potentialities	
The plan	
Economic factors involved	
The justification	
VIII. States Rights vs. Federal Rights.....	77
Legal rights vs. Economic advantages	
IX. State Attitudes Toward the Project.....	80
Arizona, California, Nevada.	
Utah and other upper basin states	
Conclusion.....	87
Appendix	

## INTRODUCTION

The recent passage of the Swing-Johnson bill by Congress and its approval by the President has been the signal for a general rejoicing throughout the West, and especially in Southern California, the section to be most directly benefited by this legislation. There has been a widespread feeling that the long fight for Federal development of this great western river is over, and that we may begin shortly to realize some concrete returns upon our investment. Press reports indicate that many are already seeking work on the construction of the dam at Black Canyon, in anticipation of the immediate launching of the project. "Wild cat" employment agencies have sprung up and are extorting fees from work-seekers by promises of good positions on the construction job. Real estate "sharks" are already active and have promoted the sale of much land which they represent as being situated in a favorable spot for irrigation from water to be impounded by the dam. Much of this land is said by the government to be situated several hundred feet above the level of the proposed dam to be unfit for use even if water were available.

To forestall this exploitation of men and land the government has recently issued a timely warning to the effect that it will be at least eighteen months before work on the construction of the dam is actually begun and that no homesteading claims on land under the project will be allowed until its com-

pletion which will be about eight years.

This announcement may come as somewhat of a shock to many optimists unacquainted with the actual provisions of the bill. To them it may be said that much depends upon the possibility of reaching a satisfactory solution of the problem of water allocation between California and Arizona. To date such a solution has not been reached and unless Arizona is satisfied it is highly probable that the question will be carried to the courts and long months of litigation ensue. If a satisfactory compromise is reached, the launching of the work will not be long delayed. Of the ultimate outcome there can be no doubt, and the future seems to hold a very rich promise for the great Southwest.

As this subject is approached for study one is somewhat overwhelmed by its many ramifications. The engineering problems alone are of tremendous scope. The legal aspects of the question furnish material for exhaustive study. The political issues tend to claim a greater place than their real merit would seem to justify. While all the different phases of the question are somewhat closely bound together, it has been the purpose of the writer in this study to draw at least a faint line of demarcation and confine it as much as possible to the economic aspects. The Boulder Canyon Project Act proposes a four fold plan of economic development; namely, flood-control, irrigation, power development and domestic water-supply. It is to these features that most attention will be given, together with the historical background of the program.

It would be only just at this point to acknowledge the very

generous response to calls sent out by the writer for reference material. More than a score of individuals and organizations responded with most gratifying results. Included in these were the governors of the seven states in the Colorado River basin, Senator Hiram W. Johnson and Congressman Philip Swing of California, co-authors of the Swing-Johnson bill; the chairmen of the Senate and House committees on Irrigation and Reclamation; the Pacific Gas and Electric Company; the Southern California Edison Company; the Boulder Dam Association, and many others.

Very generous assistance was also received at the College of the Pacific Library and the Stockton Public Library.

## EARLY HISTORY OF THE COLORADO RIVER

Public interest in the Colorado River is too often thought of as being concomitant with the introduction of the Swing-Johnson Bill into Congress, or at most not antedating the Imperial Valley disaster of 1905-06. As a matter of fact, however, this remarkable body of water has been the object of sporadic efforts at exploration and observation for about four centuries, although these efforts produced nothing in the way of a unified plan of development until very recently. Mr. Arthur Powell Davis, former director of the United States Reclamation Service, says that systematic study of the lower river really began with the passage of the Reclamation Act of 1902, which provided for the investigation of reservoir sites, irrigation projects, etc., and the carrying out of various tests and experiments.<sup>1</sup> However, during the past few hundred years a real and fruitful work has gone on, the importance of which should not be overlooked in a study of this kind.

Our earliest knowledge of the Colorado River has come down to us from the Spanish "conquistadores" and "padres", bearers of the sword and cross. Of these two groups, we owe most of our historical knowledge to the latter, who seemed to leave the more valuable records to posterity. Spanish interest was stirred for the first time when Cortez heard remarkable tales of the Seven Cities of Cibola, stories of great wealth of gold and

1. Engineering News-Record. Feb. 2, 1922.....P.184.



treasure. He forthwith dispatched an expedition, in the year 1536, to search out this place of riches. The records of the journey indicate that it failed to penetrate far into the interior. Later expeditions reached Cibola in safety, to find only a few Indian mud villages, quite devoid of the gold and silver which was sought.<sup>1</sup>

The next group to come upon the scene were the "padres". Their work was done chiefly during the eighteenth century, and the two principle figures were Fathers Escalante and Garces. The good "padres" were not particularly interested in gold, nor did they give much attention to the exploration of the river. Their duty, as they saw it, was to search out and convert the Indians to the Christian faith. Francisco Garces made five trips in all between 1768 and 1770.<sup>2</sup> The natural result of their particular interest was that their records reveal more concerning the people with whom they came in contact, and the general topography of the country, than about the river itself.

For over forty years after the last "padre" expedition under Escalante in 1777, there was no further progress in the exploration of the river. About 1820 interest was again revived when trappers began to enter various parts of the river canyon and ply their trade. Although no doubt participating in some very interesting experiences, the trappers have left us little of value for two reasons. In the first place, they were unable or unwilling to keep accurate records and, second, such records

1. Freeman, Lewis R. The Colorado River.....P. 6.

2. Water Supply Paper no. 395 .....P. 17.

as were kept fell into the hands of editors or collaborators who colored them so highly as to render them almost valueless for historical study.<sup>1</sup> Such was the case with the story of James Pattie, a trapper of unusually rich experience, whose story as told by the Reverend Flint, at that time editor of a publication in Cincinnati called the "Western Review", was so grossly exaggerated as to be quite worthless.<sup>2</sup>

Until the year 1825 there had been no attempts of any consequence made to explore the Colorado by boating into the depths of the canyon. The first reliable account of a journey of this kind is that of one made by General William Henry Ashley.<sup>3</sup> It seems that Ashley had lost a substantial fortune and plunged heavily into debt, and it was the hope of financial rehabilitation through the medium of the fur trade that led him to undertake the enterprise. Even with the poorest of preparation and equipment, he succeeded in running many of the most vicious rapids in the Green River, and left by way of record a fund of valuable information for the use of future expeditions. Much of his data was lost, however, including a valuable topographical map of the region explored.

Within a year after Ashley had given the country the first reliable information concerning the upper canyons, a young British naval officer gave us the first authentic description of the country around the mouth of the river. This account came

1. Freeman, Lewis R. The Colorado River.....P.56.
2. Ibid.....P.81.
3. Water Supply Paper No. 395.....P.19.

from Lieutenant Hardy who was employed by a British company to investigate certain concessions they contemplated working on the Gulf. He was led to attempt the navigation of the river by the need of replenishing his food supply. While he did not penetrate far, so painstaking were his efforts and so accurate his maps and records that his written account contained more accurate information relative to the physiography, hydrography and ethnology of this region than had been brought to light in the preceding three hundred years since its discovery<sup>1</sup>.

Probably the most spectacular achievement in Colorado River history was the run of William Manly and six other men down the canyons of the Green River in 1849. None of the group were boatmen. They were teamsters called west by the gold rush. Possessing a deadly fear of the Mormons, and having no knowledge of the river except that it emptied somewhere in the vicinity of California, they decided that the "water route" was preferable to the overland and embarked without a qualm of fear. Needless to say, the first span of their journey down the Green River proved quite enough and the rest of the trip was made overland. It was this party that passed over and first named Death Valley.<sup>2</sup>

It was not until 1850 that the United States government took any active interest in the exploration of the river. The first government attempt came about as the result of the establishment of a military post at the mouth of the Gila River for

1. Freeman, Lewis R. The Colorado River.....P.123
2. Freeman, Lewis R. The Colorado River.....P.140

the protection of California-bound gold seekers. Due to the difficulty of provisioning the post by land, an expedition was sent out under Lieutenant George Derby to seek out a means of access by water. Although the boat provided Derby was not suitable for navigation of the Colorado River, his report indicated the possibility of navigation for smaller craft and commercial navigation at once began. A few years later another expedition under Lieutenant Ives penetrated as far north as Black Canyon, demonstrating the practicability of navigation to that point and making many valuable scientific observations.<sup>1</sup>

The first man known to have passed through the Grand Canyon of the Colorado was Major J. W. Powell who accomplished this great feat in 1869. His expedition was carefully planned and funds were provided by the State Institutions of Illinois and the Chicago Academy of Science. The only assistance offered by the government was in the form of a permit for his party to draw rations from the nearest available western army posts. The completion of the trip was in itself a great achievement, but the difficulties were so great that the records kept were meager, the scientific results not what was desired and many instruments and much data were lost.<sup>2</sup>

With a view to supplementing the limited information gained on the first trip, Major Powell organized a second expedition in 1871. This time the task of securing financial backing was

1. Freeman, Lewis R. The Colorado River.....P.147

2. Water Supply Paper No. 395.....P. 20

relatively easy. The government was now interested and no great difficulty was encountered in securing Congressional appropriations.<sup>1</sup> Backed by the experience of the first journey, no trouble or expense was spared in the preparation for the second. The men were carefully chosen, specially constructed boats provided, and arrangements made to have supplies brought in at different points along the river. More than fifteen months were taken in making the trip and surveys between the spot where the Union Pacific railway crosses the Green River in Wyoming to the mouth of Kanab Creek. This time the records kept were accurate and were so carefully done that they have ever since been used as guideposts by those venturing into the canyon.<sup>2</sup>

The end of Powell's second expedition may be said to have marked the end of the first era of Colorado River history, the era of exploration. The interests of science appear to have been served and curiosity satisfied. In 1889 the second era opened, an era of practical utilization in the interest of economic advancement. In that year a Mr. Frank M. Brown conceived the idea that the Colorado Canyon could be used as a route for a railway into the Southwest.<sup>3</sup> He believed that such a road constructed on a low uniform gradient through the middle and lower canyons would have an immense competitive advantage with other lines having heavy gradients. The principal purpose of such a road was to carry coal into the

1. Dellenbaugh, F.S. A Canyon Voyage.....P. 3
2. Freeman, Lewis R. The Colorado River.....P.292
3. Water Supply Paper No. 395.....P. 21

Southwest, this being far in advance of the present extensive use of petroleum and electricity. A company was actually formed to carry out the plan and a party fitted out to make the preliminary surveys. The party met with disaster, however, and Brown and two others lost their lives in the canyon rapids. His engineer, Robert Brewster Stanton later completed the survey, and proved the engineering feasibility of the plan, but the lack of any economic justification prohibited the carrying out of the work.<sup>1</sup>

1. Freeman, Lewis R. The Colorado River.....P.321

## MODERN HISTORY OF COLORADO RIVER DEVELOPMENT

The modern period of Colorado River development may be said to have begun with the active studies started in the last decade of the nineteenth century by the United States Geological Survey. About 1894-5 they launched a study of the basin by the establishment of several stations in various parts of the valley for the measurement of stream discharge. They were urged to renewed and more extensive work by the Imperial Valley disaster of 1905-6, an event which helped to focus the public eye on the urgent need for a unified plan for the development and control of the river. Within the next twenty years innumerable surveys and investigations were launched for the purpose of studying dam sites, stream measurements, water appropriations, irrigation projects and power sites.

The first exhaustive study was completed by the United States Geological Survey and the results set forth in a series of papers, of which the most important was Water Supply Paper No. 395, prepared by E. C. Larue, and published in 1915. A second careful study of Mr. Larue was published ten years later as Water Supply Paper No. 556. This study was entitled "Water Power and Flood Control of the Colorado River below Green River, Utah."

Investigations were also carried on by the Reclamation Service with special reference to problems of irrigation and reclamation. One of these was undertaken in 1914, the results being embodied in a voluminous report by Mr. John T. Whistler, engineer of the United States Reclamation Service. Still another

by Mr. F. C. Weymouth, known as Senate Document 142, was so exhaustive that it would have cost \$10,000 to have it published so that up to the present time only four copies are in existence, all these being in Washington.

The next important step was the passage by Congress in May, 1920 of the so-called "Kincaid Act" authorizing the Secretary of the Interior to carry out a comprehensive study of the Colorado River with special reference to problems of flood control and economical use of the water of the stream. The secretary's report was published in 1922, containing a summary of all available information and recommending the construction of a storage dam in or near Boulder Canyon and a high line canal from Laguna Dam to Imperial Valley.<sup>1</sup>

The first bill introduced for the purpose of carrying out the recommendations of the Secretary of the Interior was presented to the House of Representatives by Congressman Philip Swing of California on April 25, 1922.<sup>2</sup> No action was taken on this bill but another was brought before the next Congress, sponsored in the House by Congressman Swing and in the Senate by Senator Hiram Johnson of California, known as the Swing-Johnson Bill. The fight was carried from one session of Congress to the next until the final passage of the bill in December 1928, when it became known as the Boulder Canyon Project Act.

In the meantime the various states of the Colorado River Basin began to realize that if development of the river took

1. Davis, A.P. The Colorado River Surveys The Community Builder. Mar. 1928.....P.14

2. Known as H.R. 11,449. 67th Congress 2nd Session.



place in advance of some kind of an agreement among the states concerned, the autonomy of these states might be seriously affected and that endless litigation over questions of water rights would certainly ensue. It was decided that an interstate treaty would be the best solution of the problem.

The Constitution of the United States provides that two or more states may enter into a treaty or compact by permission of the national government.<sup>1</sup> Congress was requested to grant such permission, which it did on August 19, 1921. This was followed by suitable action on the part of the states and representatives were appointed to what was known as the Colorado River Commission. Each state had one representative, while the Federal government was represented by Herbert Hoover who was named chairman of the group.

After a series of meetings and hearing conducted for the purpose of securing data on the question the Commission met in Santa Fe, New Mexico, in the fall of 1922 to begin the actual work of drafting a treaty. On November 24, 1922, after eighteen months of labor a seven state agreement was signed by the different state representatives.<sup>2</sup> A copy of this compact is found in the appendix. It is undoubtedly the most important feature of the Colorado River controversy and has been used as a starting point for nearly all discussion of Colorado River development.

The original purpose of the commission was to agree on a

1. Constitution of the United States. Article I Sec. 10.

2. Majority Report. S.728. 70th Cong. 1st Sess......P.14.

proper allocation of water between the states. But eighteen months of bickering demonstrated the hopelessness of achieving any such agreement, consequently the allocation finally determined upon was simply between the upper and lower basins.

According to the terms of the treaty there was apportioned, "in perpetuity to the upper basin and to the lower basin respectively, the exclusive beneficial consumptive use of 7,500,000 acre-feet of water per annum, which shall include all water necessary for the supply of any rights which may now exist." 1.

In addition, the lower basin could increase its amount by 1,000,000 acre feet, making a total of 8,500,000 acre feet. The lower basin states were defined as Arizona, California and Nevada; the upper basin states were Colorado, Wyoming, Utah, and New Mexico.

On the presentation of the compact to the legislatures of the various states involved, it received the prompt indorsement of all except Arizona. Her refusal was based on the fact that the absence of a definite water allocation between states gave her no protection against California, a more rapidly developing state. California would have put most of the water allowed the lower basin into use long before Arizona was ready for it and thus establish priority rights. A move was then initiated to make the treaty effective with the ratification of only six states. California refused to agree to this, for reasons which will be explained, and the situation was further complicated by the action of the state of Utah in rescinding her approval.

Then followed a long series of conferences, proposals and

counter-proposals, controversies of great bitterness, and finally an effort to reach a tri-state agreement for the allocation of the water of the lower basin. To date this has borne no fruit, but the next meeting of the conference on April 17, 1929 is looked forward to with great hope.<sup>1</sup>

Much of the opposition to the Swing-Johnson bill as originally drawn was caused by the belief that the project had not been thoroughly examined with regard to its engineering features and that the cost estimates were inaccurate. These first cost estimates were as follows:

1. Cost of dam.....	\$41,500,000
2. All-American Canal.....	31,000,000
3. Power development.....	31,500,000
4. Interest charges.....	<u>21,000,000</u>
Total	\$125,000,000 <sup>2</sup>

Also it was provided that this entire sum was to be paid within fifty years out of the sale of power and water. Finally a board of engineers and geologists was named by Congress to make a study during the summer and fall of 1928 on the matter of the projects feasibility and the best site. On December 1, 1928 the boards report was given, of which the following may be said to be the principal features:

1. Recommendation of the Black Canyon site.
2. Approval of engineering feasibility.
3. Revision upward of cost estimates.

1. News Item. Stockton Record March 8, 1929.
2. Scattergood, E.F. Engineering and Economic Features of Boulder Dam. Annals of the American Academy. Jan. 1928. P. 121.

4. Approval of plan for sale of power.
5. Recommendation of a treaty with Mexico determining water rights prior to the completion of the project.<sup>1.</sup>

The Swing-Johnson bill was at once revised to bring it into line with the new cost estimates and as finally passed it provided for a possible expenditure of \$165,000,000 on the project, to be apportioned as follows:<sup>2.</sup>

1. For a concrete dam 550 ft. high in Black Canyon.....	\$70,600,000
2. For a high line canal from Laguna Dam to Imperial Valley.....	38,500,000
3. For the construction of a power plant at the dam.....	38,200,000
4. Interest charges during construction @4%....	17,700,000
Total	\$165,000,000

Some changes were also made in the plan of amortization. The sum of \$25,000,000 is to be charged to flood control, the government to be reimbursed only if excess revenues are available. The cost of the All-American Canal is to be charged against the land benefitted, according to the terms of the Reclamation Act. The remaining sum of \$101,500,000 is to be amortized within fifty years from the revenue accruing from the sale of water and power. The power plant is to be constructed either by the government or by private concerns, at the option of the Secretary of the Interior.<sup>3.</sup>

An effort was also made to meet the desires of Arizona and Nevada for a share of the revenue by providing that if any

1. San Francisco Chronicle.....Dec.4,1928.
2. Literary Digest.....Dec.29,1928....P.8.
3. Literary Digest.....Dec.29,1928....P.8

excess revenue remained after making the periodic payments to the government  $37\frac{1}{2}$  percent of such excess should be divided equally between those two states. The remaining  $62\frac{1}{2}$  percent of excess revenue is to be used to repay the \$25,000,000 allotted for flood control, plus interest at 4 percent.<sup>1.</sup>

In order to assure the financial stability of the project it is required that before the work of construction is started the Secretary of the Interior must have in his possession signed contracts for the sale of sufficient power and water to amortize the cost.

It is further provided that the Colorado River Compact must be signed by at least six of the seven basin states before the work can proceed, and that a six state ratification will not be sufficient until six months have elapsed from the date of the passage of the bill to allow time for a seven state agreement. Consequently a six-state agreement cannot be valid until after June 21, 1929.<sup>2.</sup>

1. Johnson, Hiram W. Converting the Colorado River into an Asset. Current History.....Feb.1929.....P.790-1

2. See appendix for full text of the Act.

## PHYSICAL FEATURES OF THE COLORADO RIVER BASIN

The Colorado River proper is formed by the union of the Grand and the Green Rivers. Grand River has its source in the Rocky Mountains near Long's Peak, Colorado. Green River rises in Wyoming near Fremont Peak in the Wind River Mountains.<sup>1.</sup> From the junction of these two streams, the Colorado River takes a northwesterly course, and after traversing a distance of over 1700 miles empties into the Gulf of California. In the course of its journey this stream is supplemented by many smaller ones, from both north and south. The entire drainage area comprises parts of seven states, namely, Colorado, New Mexico, Wyoming, Utah, Nevada, Arizona and California. A small portion of Mexico is also included. This area totals approximately 244,000 square miles, equal to about one-thirteenth part of the United States and is distributed as follows:

1. Colorado.....	39,000 sq. mi.
2. Wyoming.....	17,000
3. Utah.....	40,000
4. Nevada.....	12,000
5. New Mexico.....	23,000
6. Arizona.....	103,000
7. California.....	2,000

	Total in U.S.      242,000 sq.mi.
Mexico.....	2,000
Grand total	244,000 sq.mi. <sup>2.</sup>

1. Water Supply Paper No. 395.....P. 12.
2. Grunsky, G.E. International and Interstate Aspects of the Colorado River Problem.      Science, November 10, 1922.P. 521

The average annual discharge of the river has been variously estimated at from 16,000,000 to 18,000,000 acre feet, the following table giving an approximation of the contributions of the different tributaries:

1. Green River.....	5,510,000 acre feet
2. Grand River (Upper Colorado).....	6,940,000
3. San Juan River.....	2,700,000
4. Gila River.....	1,070,000
5. Other tributaries.....	1,560,000

Total            17,780,000 acre feet.<sup>1.</sup>

It will be seen from these figures that the source of about 90% of the total flow of the Colorado is to be found in the upper basin states.

Another feature of great importance is the wide variation in the amount of water in the river, variation both as to annual and seasonal discharge. According to measurements made in these years during which official records have been kept, the annual discharge has varied from 8,000,000 to 27,000,000 acre feet. The seasonal flow has varied from 2,000 second feet in low season to about 200,000 second feet during flood time, usually during the months of May and June.<sup>2.</sup>

Beyond a doubt the so-called "problem of the Colorado" is the silt problem. The deposition of silt is the cause of a constant flood threat. It is a tremendous handicap to irrigation. It must be considered in the use of river water for

1. Grunsky, C.E. International and Interstate Aspects of the Colorado River Problem. Science.. Nov.10,1922. P.521
2. Engineering News-Record.....Jan.8,1925. P.57

domestic purposes. It merits some explanation at this point.

The enormous quantity of silt transported by the river is due to certain physical features of the basin which tend to cause extensive erosion of surface material. One of the most important of these is the aridity of the climate which has left a great portion of the lower basin scantily covered with shrubs and grass. This deficiency has not been caused entirely by the unfavorable climate. Many observers have expressed the opinion that prior to the entrance of the white race into this area there was no considerable amount of erosion, but that overgrazing of the land by sheep and cattle has made it a fit subject for the attack of heavy rains and winds.<sup>1</sup> The removal of timber has probably contributed somewhat to this also, although the amount of lumbering carried on in this area has been limited, and the effect of de-forestation on floods is still a moot question among engineers.<sup>2</sup>

Combined with this particular condition of the soil, which makes it subject to rapid erosion, is the common occurrence of heavy rainstorms of much violence during which the unprotected surface soils are literally swept away. It may be recalled that one such storm occurred while the United States Geological Survey party was in the Colorado Canyon in 1923, causing them considerable trouble and leading many on the outside to believe that the entire party had been destroyed.<sup>3</sup>

1. Technical Bulletin no. 67 U.S. Dept. of Agriculture.....P. 7.

2. Morgan, Arthur. The Mississippi, Atlantic Monthly, Nov. 1927. P. 667

3. Freeman, L.R. Surveying the Grand Canyon of the Colorado  
National Geographic. May 1924.....P. 524.



Still another physical factor which accentuates the silt problem is the exceedingly steep gradient of the river and of its major and minor tributaries as well. In its journey to the gulf it drops from an elevation of almost 14,000 feet to sea level. In the principal canyon sections there is an average fall of seven and one-half feet to the mile for a distance of over three hundred miles, while in the smoother stretches the average fall is about three feet per mile.<sup>1</sup> The steepness increases the turbulence of the waters to such degree that much of the debris in transport is ground to powder, the stream bed eroded and scoured clean, making impossible an even distribution of the silt burden and forcing it all into the lower basin.

On the question as to how much silt is actually transported each year in the Colorado River, there seems to be some difference of opinion. Two government departments have made rather extensive studies of the question, taking daily samples over a period of several months. On the basis of measurements made at Topock, the Department of Agriculture placed the annual silt burden at 253,628,000 tons, or about 137,000 acre feet.<sup>2</sup> The Department of the Interior carried on their tests at Yuma, much farther downstream, and estimated the amount at about 90,000 to 100,000 acre feet.<sup>3</sup> It has been suggested that the difference between these two sets of figures are accountable to the fact that the measurement at Topock was made at a spot where

1. Engineering News-Record.....Jan. 8, 1925.....P. 57

2. Fortier and Blaney. Silt in the Colorado River, Technical Bulletin No. 67. U.S. Dept. of Agriculture.....P. 4

3. Hearings on H.R. 5773, 70th Cong. 1st Sess......P. 480

the river flow was more rapid and was carrying the entire silt burden in suspension, whereas at Yuma where the river is more smooth, much of the silt would be rolled along the bottom and could not be measured.<sup>1</sup> If this be true the figure of 137,000 acre feet is the more accurate. In either case the burden of silt is tremendous and creates serious problems in the lower basin.

1. Hearings on H.R. 5773, 70th Cong. 1st Sess......P.480.

## FLOOD-CONTROL

By far the most important of the problems created by this continuous deposition of silt is the danger of constantly recurring floods in the lower basin. This danger is most acute in Imperial Valley due to the peculiar topographic conditions found there.

Imperial Valley proper is entirely below sea level, some portions being from 250 to 300 feet below. In former geologic ages it was a part of the Gulf of California. In fact, the gulf once extended northwest to a spot above the present town of Indio, some 144 miles from its present head.<sup>1</sup> While geologists may speak of this as having been in "recent geologic times", it really goes back into antiquity and long antedates human history. It is thought that the change which altered this condition took place during the geologic age known as the Pleistocene or Glacial period. At that time, due to unusually heavy precipitations of rain and snow, the river reached its maximum transporting power and began to carry down heavy loads of debris and silt. Entering the gulf at a spot just below the present mouth of the Gila River, it began dropping its load and formed a delta cone which gradually extended westward and southward across the upper end of the gulf. Finally the upper end was completely cut off from the main body of water and formed a great inland sea.<sup>2</sup>

1. Weymouth, F.C. Conservation of the Waters of the Colorado  
Science. July 21, 1922.....P.59.

2. Cory, H.T. Imperial Valley and the Salton Sink.....P.8

According to evidence presented by the layers of shells found there, this sea finally evaporated but the basin was soon filled with fresh water from the river. This was repeated on several occasions, and the basin seems to have been used as a sort of playground by the river, as the river channel shifted first to the right and then to the left of the delta.<sup>1</sup>

The important thing for the present generation to realize, however, is not the fact that this went on some ages ago, but that the shifting tendency persists at the present time. The gradual deposit of silt has built up the delta and the bed of the river until now we have the interesting but dangerous phenomena of a river, much higher than the surrounding country, running around the saucer-like rim of the valley, constantly threatening to break through its soft alluvial banks, pour into the sink some 200 feet below and inundate thousands of acres of farmland.

Imperial Valley has already had a taste of the power of the Colorado out of control. It was the disaster of 1905-06, and subsequent minor floods, that has formed the main basis for the desire for more adequate protection of the valley. A brief resume of these events will suffice to indicate the foundation for the fears entertained by the residents of the valley.

As noted elsewhere, the pioneer company in the field of irrigation in Imperial Valley was the California Development Company. The first intake to the canal system which they constructed was at Pilot Knob. Within a short time, however,

1. Newell, R.H. Shall We Dam the Colorado? Review of  
Reviews Dec. 1927.....P.631.

it became evident that this intake would not be satisfactory. The silt deposits gradually raised the canal bed to such a high level that it became increasingly difficult to secure enough water. Occasional water shortages were felt, causing distress to the settlers who in turn presented claims to the company for settlement.

In the summer of 1904 the floods left an unusually heavy deposit and the company realized very shortly that it would be impossible to remove the silt in time to meet the demands of irrigation during the low water season. Several attempts at removal proved futile, and finally it was decided to open a new intake on the Mexican side of the line, so that a deeper channel could be secured to carry a larger head of water.<sup>1</sup> Careful provision was made to close the intake before the summer floods, but a succession of unusual winter and spring floods made the task more difficult than had been expected. Before it could be completed in the summer of 1905 the raging June floods swept away all obstructions, widened the breach and turned practically the entire flow of the river once more into the old Salton sink. Many homes and other buildings were swept away, roads were torn out, and thousands of acres of carefully prepared agricultural land hopelessly gutted and ruined.

It is perhaps not the place here to describe in detail the efforts to close the breach and turn the river back into its regular channel. The tremendous power of the flood, coupled with the inadequacy of material with which to work made it exceedingly difficult. The California Development Company

1. Cory, H.T. Imperial Valley and the Salton Sink.....P.1387

proved financially unequal to the task and the burden was shouldered by the Southern Pacific Company. After eighteen months of herculean effort they succeeded in closing the cut. Over \$4,000,000 had been spent on this job<sup>1</sup>; most of it being provided by the Southern Pacific which has never yet been reimbursed.

During the eighteen months of its flow, enough water had passed into the sink to create a lake of some 300 square miles, known as the Salton Sea. More than 100,000 acres of fine land was permanently inundated and at least 25,000 additional acres so cut up and washed over as to be permanently lost to cultivation. In addition to this, eight lives were lost in battling the floods.<sup>2</sup>

Following this catastrophe the United States government spent \$1,000,000 to build what is known as the Ockerson Levee to prevent a possible repetition of the disaster. It had been scarcely completed when another flood swept much of it away and the river once more left its old channel, flowing through what is known as Bee River into a depression on the Mexican side of the line called Volcano Lake. By the year 1919 the silt had filled the Bee River channel and Volcano Lake to such an extent that the river once more became uncontrollable. An artificial channel was then built at a cost to the Imperial Irrigation District of \$700,000 from Bee River to Pescadero River from whence it was turned into another depression. It is through this artificial channel known as the Pescadero cut that the

1. Kenman, Geo. The Salton Sea .....P.90

2. Hearings before the House Committee on Rules 70th Cong. 1st. Sess.  
p.73

river now flows.<sup>1.</sup>

None are optimistic enough, however, to look upon this as a permanent solution. Even as the Volcano Lake depression was filled so must the present one be ultimately filled and when this is done it will become all but impossible to prevent the river from turning again into the one remaining lowland, Imperial Valley. It is believed by those familiar with the habits of the river that the Pescadero Cut will not serve for more than fifteen years, after which a new solution will have to be found.<sup>2.</sup>

It is not Imperial Valley alone that is threatened by these floods. The Palo Verde, Yuma, and Parker Projects have all in turn suffered heavy losses. In Palo Verde Valley there are several small towns, and farms that produce crops valued at millions of dollars annually.<sup>3.</sup> Early in June 1922, the river suddenly swung from its course and inundated over 40,000 acres of land in the valley. More than one million dollars worth of standing crops were ruined and thousands of people made homeless. In the town of Ripley the water stood several feet deep in the streets and heavy property losses were sustained.<sup>4.</sup>

In the summer of 1916 water stood four feet deep in the town of Yuma and threatened its total destruction. In 1921 a break in the levee caused the inundation of 1200 acres in Yuma Valley.<sup>5.</sup> On several occasions floods have caused serious

1. Majority Report. S. 728 70th Cong. 1st Sess......P.18
2. New Reclamation Era. April 1924.....P.51
3. Current History July 1923.....P.652
4. Majority Report S. 728 70th Cong. 1st Sess......P.19
5. Hearings before House Committee on Rules. 70th Cong. 1st. Sess......P.73

damage to the Parker Indian Reserve and to the city of Needles.

The peculiar position of Imperial Valley, however, makes her problem one of overshadowing importance. A position below the level of the river and the sea makes the use of levees a temporary relief only, and a tremendous cost to maintain in the face of the ever growing deposits of silt. This dropping of silt, and the fact that it is of this soft alluvial material that the levees must in the main be constructed, has led both engineers and laymen to realize that levee construction never can be a permanent solution. This conviction was expressed some fifteen years ago by a famous engineer and expert on Colorado River problems, Mr. E. C. Larue, when he stated that:

"Obviously no amount of levee construction and bank revetment will prevent high water stages on the lower Colorado, and if floods are not prevented thousands of dollars must be expended annually in protective works.....For the prevention of extremely high stages only one method is available--the construction of properly located storage reservoirs of sufficient capacity to hold back the flood-making waters.<sup>1</sup>"

A more extensive acquaintance with the idiosyncrasies of the Colorado evidently only served to deepen this belief, for ten years later he again warned the government that:

"Although millions of dollars have been spent in constructing levees, these works alone, however well maintained cannot assure protection from the flood menace.<sup>2</sup>"

Not only is the protection afforded by levees wholly inadequate but it has also proven very costly. Up to and including the year 1924 more than \$10,000,000 had been expended in an only partially successful effort to solve the problem by

1. Water Supply Paper no. 395.....P.191

2. Water Supply Paper No. 556.....P.17.



this means.<sup>1</sup> This sum had been divided as follows:

U.S. Reclamation Service.....	\$3,070,000
Special Congressional Acts.....	1,110,000
Southern Pacific Company.....	3,000,000
Imperial Irrigation District.....	3,115,970

It has been repeatedly urged by opponents of the Boulder Canyon project that the danger from floods has been over-magnified and that in reality it is of little moment. Congressman Douglas of Arizona has insisted that there is no danger to life, that only eight lives were lost in 1905-06, and all these due to carelessness, and that a second flood would be even less dangerous than the first due to the tendency the river would have to follow the channel made in 1905.<sup>2</sup>

There seems to be abundant room for wide division of opinion on most questions relating to Colorado River development. It would appear, however, that there should be less difference on this question of the reality of flood danger than on any other single phase of the subject. A mere study of the facts of history should convince one that the danger is genuine. Perhaps this difference is due to a tendency to regard a thing as dangerous only when it menaces human life. Undoubtedly the greatest threat to Imperial Valley is to property, but the danger to life is not absent.

The very topography of the land, quite without the aid of expert testimony, should be sufficient to convince one of the

1. Hearings before House Com. on Rules. 70th Cong. 1st. Sess. P. 73

2. Douglas, L.W. Minority Views. H.R. 5773 70th Cong. 1st. Sess. p. 5

possibility of future disaster. But expert testimony is not lacking. Engineers of the Reclamation Service have repeatedly urged the necessity of prompt action. Such men as Arthur Powell Davis, F.E. Weymouth, General Goethals, William Mulholland and Herbert Hoover have joined in testifying as to the reality of the problem.<sup>1</sup>

Further evidence, if any were needed, might be found in the opinion of those whose duty it is to know the facts of the situation from a purely business standpoint. In the fall of 1927 an effort on the part of an Imperial Valley land owner to secure a loan from the Federal Land Bank elicited this reply:

" Answering yours of Oct.29, this bank ceased making loans in Imperial Valley some years ago, and we must stay out of that territory until the flood hazard has been eliminated.

Very truly yours,

The Federal Land Bank of Berkeley,  
by Simms Ely, Treasurer."<sup>2</sup>

Even on the Arizona side of the river this danger has been felt and the Boulder Canyon Project has received the official endorsement of the Mojave County Chamber of Commerce and also the Yuma Chamber of Commerce.<sup>3</sup>

As regards the suggestion that the danger of a second flood would be lessened by the likelihood that the river would follow the old channel, there are two reasons why this thought fails to bring much comfort.

1. Majority Report. S. 728 70th Cong. 1st. Sess......P.20

2. Johnson, Hiram W. Speech in U.S. Senate. April 26, 1928.

3. Hearings on H.R. 5773. 70th Cong. 1st Sess......P.174-5

First there is no assurance that such will be the case. There is no reason to feel certain that a second break need occur in the same place as the first. There are other possibilities, as for example the one suggested in the question:

"What would happen if the break occurred at the Volcano Lake Levee at the height of flood season, with 100 square miles of water 10 to 15 feet high backed up against the levee?"<sup>1</sup>.

Perhaps an even greater danger, however, is that the second flood actually would follow the old channel. The cause for concern over this possibility can be appreciated only when we understand what happened in 1905-06. When the flow of the river came through the New River channel it eroded a gorge some 43 miles long, averaging 1000 feet wide and from 40 feet to 80 feet in depth. But this did not take place as a gradual uniform deepening of the channel. It came through a recession such as takes place at the head of a falls. The upstream movement of its face was at times as much as eight miles per month.<sup>2</sup> The real danger thus becomes apparent. If a flood poured through this channel long enough, this recession would continue back to the river, destroy the intake and cut into the bed of the river itself, perhaps even travel up the river some 300 miles destroying Laguna Dam and all irrigation projects on the lower river.

Still another point of attack on the project is seen in the serious contention that the property values in Imperial

1. Swing, Philip. Should the Boulder Dam Bill be Passed? Congressional Digest. June 1928.....P.198
2. Entemann, P.M. Flood Danger in the Colorado Delta Engineering News-Record Mar.31,1927.....P.532

Valley are not great enough to justify the expenditure of such sums as would be necessary for their protection. This point was argued by Congressman Douglas before the House Committee on Rules. Estimating the total property values at \$100,000,000, and quoting figures to show that the assessment figures were only slightly in excess of \$36,000,000 he concludes that:

"It follows inevitably as the night follows the day that it is not good business to appropriate \$125,000,000 to protect property which is not worth that amount of money."<sup>1</sup>.

It will be seen at once, of course, that these figures do not present a true picture. One is left to assume that the entire original estimated cost of the project including dam, power plant and canal was chargeable to flood protection. Such was never the case, and this is made more clear by the bill as finally passed, which prescribes a definite sum, \$25,000,000, to be charged against flood control.

Again, while the figures given as to property values may have been substantially correct at that time they could not be accepted now. In spite of the very great economic handicap of flood threat, property values have increased rapidly in Imperial Valley within the last few years. A table of figures compiled by the Imperial County Board of Trade places the county values at \$188,855,784. This figure probably reflects the enthusiasm of most such organizations. A truer picture may be gained by a study of the annual assessed valuations. The round

1. Hearings before House Committee on Rules. 70th Cong. 1st Sess.  
p. 54

figure of \$36,000,000 quoted above was for 1926. By 1927 this had grown to \$48,000,000 and in 1928 to \$54,000,000 an increase in two years of 50 percent. A fifty percent increase of Congressman Douglas' figure would indicate present values of at least \$150,000,000.

We should further take cognizance of the fact that Douglas did not include property values of the Yuma, Palo Verde, and Parker Projects. These also merit protection, making a total valuation of above \$200,000,000 which would seem to be sufficient to justify an expenditure of \$25,000,000. Finally it may be easily understood what effect the present feeling of uncertainty has in property values. That such increase as before noted has actually taken place is little short of phenomenal. Capital for development is difficult to get, interest rates are high and many feel that the actual present values of property are less than half what the income would justify.<sup>1</sup> This tendency toward a depression of values must continue to exist until the flood menace is removed.

From a purely economic standpoint, quite aside from any consideration of danger to human life, it would seem that the amount which it is proposed to expend for flood protection is well justified. Enormous annual expenditures are now necessary for the construction and maintenance of levees. Large additional expenditures are necessary to maintain silt-free canals and irrigation ditches. And finally even these great costs do not solve but only postpone the inevitable day of reckoning.

1. Majority Report. S. 728 70th Cong. 1st Sess......P.20

## IRRIGATION AND THE ABL AMERICAN CANAL

The storage of water for irrigation and reclamation has been put forward as the second reason for the Boulder Canyon Project. The possibility of securing a much needed increase in the amount of water available for Imperial Valley, and of reclaiming additional lands now arid, offer an interesting field of speculation.

One of the most remarkable developments of the present century has been the expansion of the government into the field of irrigation and reclamation. Given impetus by the Reclamation Act of 1902, the movement has extended rapidly and many projects all over the United States now stand witness to the energy and activity of the Bureau of Reclamation.

Nor has the field of irrigation been confined to governmental agencies alone. Many private companies have made great contributions to the movement, and it is to the initiative displayed by private individuals that California must acknowledge indebtedness for the present status of irrigation in Imperial Valley. To gain a proper background for understanding the problems and possibilities of this locality, it is both profitable and interesting to go back some years and briefly trace its development.

The present generation is by no means the first to recognize the real value of the waters of the Colorado. Americans seem to have been the first people to use the river for irrigation, but they were Americans of the old stock and the time is

so far back as to be a part of unrecorded history. Investigations have disclosed remnants of ancient ditches and reservoirs in the basins of the Gila and Little Colorado Rivers which were in use long before the beginnings of Spanish explorations in the sixteenth century.<sup>1</sup> Nor were these early attempts so crude as one might suppose. Many of the ditches and reservoirs were lined with hard clay, and one canal was found to have been cut for a considerable distance through solid rock. In the Salt River Valley in Arizona are found ancient canals totaling over one hundred and fifty miles in length and sufficient to serve at least 250,000 acres of land.<sup>2</sup> Some of the more important crops appear to have been cotton, corn, beans, squash and tobacco.

The first Europeans to carry on irrigation in this section were the Jesuits who established themselves here during the eighteenth century. Later during the Mexican rule many orchards were planted and barley, wheat, corn, tobacco and some vegetables were raised. It was the Mexicans who first adopted certain rules and established customs relating to the use of water which have had a profound influence in the shaping of our present laws on the subject.<sup>3</sup>

The modern stage of development may be said to have begun with the movement of settlers onto the land acquired by the Gadsden purchase of 1854. The first modern irrigation works were constructed in the upper basin states of Wyoming, Colorado, and

1. Water Supply Paper No. 395.....P.114.
2. Ibid.....P. 4
3. Water Supply Paper No. 395.....P.114

Utah in the early fifties.<sup>1</sup> But while the lower basin was forbidding to some, it proved attractive to others even at this early date. In 1853 a Dr. O.M. Wozencraft of San Francisco, aroused by reports of the wonderful soil fertility of the southernmost part of California, made an attempt to secure capital to reclaim this desert land. His efforts resulted in the California Legislature presenting a memorial to Congress asking for a cession of 3,000,000 acres of desert land in southeastern California for reclamation and irrigation. In 1862 the House Committee acted favorably on the request but the bill failed of passage.<sup>2</sup>

The next serious attempt at reclaiming this desert waste began with the formation of the Colorado River Irrigation Company in 1891-2. The panic of 1893 ended the aspirations of this company and it was succeeded by the California Development Company in 1896.<sup>3</sup>

This company found itself faced with several serious obstacles. The most important for our consideration was the practical impossibility, within reasonable financial outlay, of carrying the water from the Colorado River to Imperial Valley on American soil. Two years were spent in a vain effort to secure permission from the Mexican government for the American corporation to hold and acquire rights of way for canals through part of Mexico. In the end it was found necessary to form a subsidiary

1. Water Supply Paper No. 395.....P.114
2. Cory, H.T. Imperial Valley and the Salton Sink.....P.15
3. Ibid.....P.1252



Mexican corporation to carry out the plan. The water was then carried for some 50 miles through Mexico using the old channel of the Alamo River and then brought through several branch canals into Imperial Valley.<sup>1</sup>

The floods of 1905-06 proved to be the nemesis of the California Development Company. Various interests suffering losses filed suit for recovery against the company and were so successful in the litigation that on December 16, 1909 the company was declared insolvent by the Imperial County Superior Court.<sup>2</sup> In the summer of 1911 the people of the valley voted by majority of 1304 to 360 to form the Imperial Valley Irrigation District, which operates at the present time.

According to figures compiled a few years ago by the United States Reclamation Service there was at that time some 2,600,000 acres of land under irrigation in the entire Colorado River basin. The following table indicates the distribution of this land, and also indicates the Reclamation Bureau's estimate of the amount available for future development:

	Present	Immed. Future	Ultimate
Upper Basin	1,450,000 A	2,200,000 A	4,200,000 A
Lower Basin U.S.	1,000,000	1,000,000	2,500,000
Lower " (Mex.)	190,000	490,000	800,000
Total	2,640,000	4,290,000	7,500,000 B.

There is a wide difference of opinion on the question as to how much land may be regarded as ultimately susceptible of

1. Cory, H.T. Imperial Valley and the Salton Sink.....P.1252
2. Ibid.....P.1431-32
3. Engineering News-Record....Jan.8,1925.....P.59

irrigation, and these figures represent only the estimate of one organization. A somewhat different picture is presented in a report of the Arizona Engineering Commission which estimated that in the State of Arizona alone there were not less than 2,350,000 acres of land which could be irrigated profitably.<sup>1</sup>

Another interesting set of figures are those compiled by Mr. J.C. Allison, formerly chief engineer of the California Development Company. His estimates have to do with potential development in different parts of the lower basin:

1. Imperial Valley (Mexico).....	740,000 A.
2.       "       " (U.S.including present area).....	448,893
3.       "       " (outside present area).....	323,000
4. Coachella Valley.....	100,000
5. Yuma Project.....	100,000
6. Palo Verde.....	65,000
7. Above Palo Verde, including Parker.....	90,000
	<hr/>
Total	1,866,893 A <sup>2</sup> .

The most important of the existing projects in the lower basin are Imperial Valley, Yuma, Palo Verde and Parker. If most attention has been given, in the campaign for Boulder Dam, to the Imperial Valley it is because the greatest pressing need has seemed to exist there and it is the people of that section that have felt most keenly the evils of present

1. Report of Arizona Lands Irrigable from the Colorado River. Arizona Engineering Commission, 1922-23.....P.35.
2. Allison, J.C. Conditions in the Colorado Delta. Engineering News-Record, Mar.17,1927.....P.444

conditions. Present and possible future water shortages must be felt of course in varying degrees by all these projects.

Imperial Valley seeks two things: a storage reservoir, and a canal built on American soil. The reasons for these two projects are separate and distinct, and will receive separate consideration.

There seems to be two well-defined ways by which a storage dam on the Colorado can be a benefit to Imperial Valley, first, by increasing the water supply available for irrigation and second, by providing a settling basin for silt which causes serious distress at the present time.

The need for augmenting the present water supply arises from the variable flow of the river, both as to seasons and as to years. Not infrequently in the past, during low water season, the entire flow of the river has been diverted at the intake to the Imperial Valley Canal and at times even this has not been sufficient. In 1924 there was a period of 96 days during which every drop of water was taken, yet after proper division had been made with the lands on the Mexican side the shortage was so serious as to result in a crop loss of \$5,000,000.<sup>1</sup> For several days during this time there was scarcely enough water delivered in Imperial Valley to meet the needs for stock and for domestic purposes. The gravity of the situation thus created may be better realized when we understand that less serious shortages are of rather frequent occurrence, and that the needs are being increased each year by the extension of

1. Hearings on H.R. 5773. 70th Cong. 1st. Sess......P.482

irrigated areas.<sup>1.</sup>

The second reason for a storage dam is the necessity of a place of deposit for silt. As already pointed out, the total amount of silt carried in the Colorado has been estimated at from 100,000 to 137,000 acre feet per annum. It is only natural that a large percentage of this should find its way into Imperial Valley canals, and that considerable quantities should be deposited on the irrigated areas. While it is true that silt is the creator of much of the agricultural wealth of the lower basin, it is also a serious obstacle in the way of the development of irrigation.<sup>2.</sup>

The first inconvenience and expense comes in the removal of the deposits from the canals. Mr. M. J. Dowd, superintendent of the Imperial Valley Irrigation District has estimated that 24,000 acre feet of silt is deposited in the canal system each year.<sup>3.</sup> He graphically illustrates the significance of this figure by saying that if that amount of silt were brought by trainloads and dumped in at the headings it would be equivalent to seventy-eight train loads per day, of forty cars each.

Mr. Dowd has also given us these figures on the cost to the district in 1923 and 1924 for the removal of silt from the intake and throughout the canal system:

1. Hearings on H.R. 5773. 70th Cong. 1st Sess......P.482
2. Fortier and Blaney. Silt in the Colorado River. Technical Bulletin No. 67. U.S. Dept. of Agriculture......P.1
3. Transactions of Commonwealth Club of California. April 13, 1926.....P.77

	<u>1923</u>	<u>1924</u>
Intake.....	\$36,965	33,343
Main Canals.....	105,547	100,331
Secondary Canals and Waste Ditches.....	436,990	394,463
New River and Salton Sea..		30,995 <sup>1.</sup>

The total annual cost of silt removal is estimated by Professor Durand to be about \$1,500,000.<sup>2.</sup>

One of the principal places of silt deposit has been at the canal intake. So troublesome has been this problem in the past that the location of the intake has been changed from time to time. At one heading two suction dredgers are constantly at work, one 18-inch and one 20-inch machine. These two each year excavate from 1,000,000 to 1,500,000 cubic yards of sand. It is found cheaper to remove it here in so far as possible, and it has been necessary to keep the intake channels quite low on account of the very low diverting weir.<sup>3.</sup>

It is manifest that not all of the silt is deposited and removable at the intake. Only the heavier particles are dropped here, the finer being carried on in suspension. It has been necessary to carry on a constant program of dredging through the entire canal system. This has tended to constantly raise and widen the canal banks, making them a source of growing trouble and menace.<sup>4.</sup>

1. Technical Bulletin No. 67. U.S. Dept. Agriculture.....P. 29
2. Hearings on H.R. 5773. 70th Cong. 1st Sess......P.481
3. Transactions Commonwealth Club of Calif. Apr. 13, '26..P. 78
4. Hearings on H.R. 5773. 70th Cong. 1st Sess......P.481

But even the removal of silt from canal beds does not solve the whole problem. The greater part of the silt is so very fine that it is carried out on the irrigated lands. The most of the silt so carried is fine enough to pass through a 300-mesh sieve, or finer than Portland cement.<sup>1</sup> It does not require the ability of a skilled engineer to foresee the ultimate results of this process. The irrigated areas are being gradually built up until they will finally be as high as the canals, making it impossible to get water on the land except by the construction of a new canal system with a higher intake.<sup>2</sup>

In still another way is a possible injury being done to the land. While ordinary silt deposits tend to enrich the land and make it more productive it seems doubtful if the deposit of such very fine material can result in anything but harm. There would seem to be a danger of the land becoming choked and impervious in the course of time to the great injury of its productive power. Finally it will be remembered that all of the domestic water supply for the homes of Imperial Valley is supplied through these canals and there must be a very considerable expense involved in the filtration of the water before it can be made fit for domestic purposes.

From the foregoing facts we are able to gain some idea of the tremendous economic waste caused by present conditions, and can recognize the importance to Imperial Valley of a desilting reservoir such as that to be built in Black Canyon. Experts

1. Technical Bulletin no. 67 U.S.Dept. of Agriculture.....P.37.

2. Technical Bulletin No. 67 U.S.Dept. of Agriculture.....P.40.

seem agreed that such a reservoir will provide the only permanent solution of the problem. Temporary palliatives only serve to emphasize this fact. While some silt will be carried in the river below the reservoir, especially during the first few years after its construction before the river bed is scoured clean, it seems likely that a great improvement in the situation should be manifest at once and this should increase gradually as time goes on.

One of the main provisions of the Boulder Canyon Project Act is for the construction of the so-called All-American canal. It remains now for us to inquire into the nature of such a canal, the purposes to be served, its cost, and other problems of this nature.

The present canal serving Imperial Valley has its intake at Rockwood heading on American soil, about one mile above the international boundary. It passes southward into Mexico, thence west some 50 or 60 miles and again enters the United States through a number of smaller branch canals. The presence of the canal on Mexican soil has given rise to international problems leading to a demand for a canal solely on American territory. When the water crosses the line into Mexico all jurisdiction over it is lost by Americans as such and it does not again become theirs until it once more enters the United States. Let us look for a moment at the possibilities involved in such a situation.

First, the entire life of Imperial Valley is dependent on the continued good will of Mexico. Senator Hiram Johnson points out that:

"If the ditch were cut there, or a few sticks of dynamite were used by those who were hostile to us not only would the lands be dried and the crops be destroyed, but the people themselves would be required to leave their homes because unable to obtain drinking water." 1.

The possibility of such a thing actually coming to pass may not seem so remote when we think of the notoriously unsettled conditions in the southern republic.

The second problem that has caused some embarrassment to Americans is the impossibility of being assured drinking water free from contamination. Mr. Mark Rose, a director of the Imperial Valley Irrigation District has explained that inasmuch as there is no law in Mexico forbidding the grazing of live stock along the canal banks, it is not an uncommon thing to remove a dead horse or cow from the canal, and further that:

"in one week we took out the bodies of three murdered men at one headgate.....Another time we pulled out a span of horses and a wagon...and the Mexican people wash their clothes in our canals and bathe in them." 2.

A third serious problem arises from the fact that one-half the flow of the canal is reserved for the use of the lands on the south side of the international boundary. At the time the original contract was drawn this provision doubtless seemed harmless enough as very little water was actually used on the Mexican side. But now the situation is radically altered. With approximately 500,000 acres of land being irrigated on the American side and somewhat less than half that amount in Mexico, the entire low flow of the river is

1. Speech in the U.S. Senate.....April 26, 1928.

2. Hearings on H.R. 2903 68th Cong. 1st Sess......P. 270



being utilized, mostly for American land. Mexican land owners may therefore bring more land into use demanding the full 50 percent of the water and thus not alone preventing any extension of irrigated areas in Imperial Valley, but perhaps even forcing some now irrigated to be withdrawn and returned to the desert.

It thus appears that the landowners in the Imperial Irrigation district are in a rather unenviable position and their interests are really subordinate to those of the Mexicans, in spite of the fact that the Americans

"have to maintain and police the levees that protect Mexican land as well as their own. They have to operate under very difficult conditions. Sometimes they even have to pay tariff charges when shifting mules across the border in carrying out emergency work on canals and levees!"<sup>1</sup>

It has been assumed by some that the construction of the Boulder Dam and All-American Canal will somehow automatically solve this international question and prevent undue expansion in Mexico. This is not true. On the contrary, there is a danger of the situation being made more acute and complicated. This has been pointed out by Mr. Douglas of Arizona. He calls attention to the fact that at least 10,000,000 acre feet of water annually must be drawn from the reservoir to generate the amount of electric power necessary to provide revenue. At the present time American lands are not prepared to use over half this amount for irrigation. The rest must pass into Mexico where it may be put to beneficial use and priority rights.

1. Mead, Elwood. Utilization of the Colorado River. New Reclamation Era. Mar. 1926.....P.40

established which would make it forever impossible for Americans to regain its use.<sup>1</sup> It was a recognition of this situation that has caused many to withhold their support from the project until some international agreement had been reached. The board of engineers and geologists which recently reported to Congress on the question of proposed sites took cognizance of this and incorporated in their report a recommendation that a treaty with Mexico be concluded in advance of the completion of the proposed storage dam.<sup>2</sup>

While the international situation just described has been the principal motivating force behind the move for an All-American Canal, other considerations have also played a part. One of these is the possibility of greatly increasing the irrigable area. The proposed canal is to have its intake at a higher point on the river and will extend into the valley at a somewhat higher elevation than does the present one. It is estimated that at least 200,000 acres more land may be irrigated by gravity than is possible at the present time.<sup>3</sup> This is especially important to that section known as Coachella Valley which lies at the northern end of Imperial Valley. Coachella Valley is now irrigated by pumping, being above the level of canals, and due to the relatively small drainage area the water table is being gradually forced down. It is feared that the water may ultimately be exhausted and the ranches returned to the

1. Douglas, L.R. Minority Views. H.R. 5773. 70th Cong. 1st Sess. p.41.
2. San Francisco Chronicle, Dec. 4, 1928.
3. Hearings on H.R. 5773, 70th Cong. 1st Sess......P.485

desert.<sup>1</sup> In this section there are now 13,000 acres under irrigation and 72,000 acres additional land susceptible to irrigation from the proposed canal.<sup>2</sup>

Some 200,000 acres of the land around the rim of Imperial Valley is the property of the United States.<sup>3</sup> This is not now open to entry, and the plan is to give first preference to ex-service men when the land is brought under a canal system and opened for entry.

Another situation which has emphasized the need for a change in the canal system has been the difficulty attending the diversion of water into the present canal. At the present time the headworks consists of a delivery gate some 750 feet long in the west bank of the river a little over a mile above the boundary. This is known as Rockwood Heading. On account of silt deposits it has been impossible to construct and maintain a permanent diversion weir without danger of flooding the Yuma Project. Some sort of diverting weir, however, was necessary but an attempt to provide temporary works was met by a court injunction secured by the Yuma Project against its construction.<sup>4</sup> An agreement was finally reached with Yuma whereby temporary works might be placed in the river each year by the Imperial Irrigation District, providing that the latter assume full responsibility for any damage which might be done to the Yuma Project by reason of the existence of such a dam. They are also

1. Majority Report S.728 70th Cong.1st Sess......P.24
2. Ibid.....P.24
3. Ibid.....P.21
4. Majority Report S.728 70th Cong.1st Sess......P.24

required to annually execute a bond in the sum of \$500,000 to guarantee such payment.<sup>1</sup> It was also agreed that they must change the point of diversion as quickly as possible and they are required to make bi-monthly reports to the War Department as to the progress made.

These temporary weirs have been constructed annually since 1915. They were at first of pile trestle and rock fill construction at a cost of from \$100,000 to \$125,000 each year. In 1918 a new system was used, comprised of a series of brush mats laid across the river. These were more cheaply laid and readily destroyed in case of sudden floods.<sup>2</sup>

The principal question involved in the construction of the All-American Canal, and the central point of attack by its enemies, has been that of its engineering feasibility. It would not be profitable here to enter into any prolonged discussion of purely engineering problems. The overwhelming weight of expert testimony on the subject from members of the engineering profession seems to be well summed up in these words of Professor Durand:

"There is no question whatever, of the engineering feasibility of the undertaking. The operations required are all well known, and are all within the domain of present well-established and approved engineering practice."<sup>3</sup>

Perhaps the most exhaustive study yet made on the engineering aspects of the question was that of the All-American Canal Board. A contract drawn up between the secretary of the Interior and

1. Majority Report S.728 70th Cong. 1st Sess......P.24
2. Engineering News-Record . May 5, 1921
3. Hearings on H.R. 5773 70th Cong. 1st Sess......P.486

the Imperial Irrigation District on February 16, 1918, provided for the appointment of a board of three members to make such a study. One member of this board was to be named by the Secretary of the Interior, one by the Imperial Irrigation District and one by the University of California. This board, composed of Dr. Elwood Mead, W.W. Schlecht and C.E. Grunsky, determined upon the proposed canal and recommended its construction.<sup>1</sup> Various other outstanding engineers such as Arthur P. Davis, F.C. Weymouth and former Governor Scrugham of Nevada have agreed that, in the words of the latter,

"The proposed canal itself is undoubtedly feasible from an engineering point of view. All operations necessary for construction are of common practice and offer no special difficulties." 2.

The principal cause for concern has been the fact that the proposed canal must pass for quite a distance through drifting sands. Some engineers have claimed that the maintenance cost through the sandy country would be absolutely prohibitive.<sup>3</sup>

A very careful study by Mr. C.G. Frisbie, a consulting engineer of Los Angeles, leads him to a different set of conclusions: First that the amount of drift sand is comparatively small; second, that the canal might be concrete lined and given sufficient gradient to carry off the sand, and third, that the movement of sand could be largely forestalled by the planting of shrubs and vegetation along the banks and in the area

1. Majority Report S.728 70th Cong. 1st Sess......P.21-22
2. Hearings on H.R. 5773. 70th Cong. 1st Sess......P.522
3. Transactions of Commonwealth Club of Calif. Apr.13,1926..P.72

adjacent to the canal.<sup>1</sup> The same fear of sand movement was once entertained with regard to the Suez Canal, but has proved ill-founded.

The question is also raised as to whether the cost of the proposed canal can be kept within limits which will make it possible for the land to pay the cost of construction. The original estimate made in 1919 was \$31,000,000. Later estimates indicated that these figures might be materially reduced, due to recent improvements in excavating machinery which would tend to bring down construction costs.<sup>2</sup> Yet when the bill passed Congress it provided for a possible expenditure of \$38,500,000, a sum which would seem amply large for the purpose.

This sum is to be paid through annual charges against the land according to the provisions of the Reclamation Act. It has been thought by many that the burden so imposed would be far too heavy to be justifiable from an economic standpoint. According to the figures of the Secretary of the Interior, based on the original estimate of \$31,000,000 the cost per acre for all construction charges, including the present bonded indebtedness of the Imperial Irrigation District of \$25.50, will be as follows:

Imperial Irrigation District.....	\$66.00
New lands under All-American Canal.....	90.40 <sup>3</sup>

These figures, seemingly large, do not appear so formidable when compared with those of other government irrigation

1. Hearings on H.R. 5773. 70th Cong. 1st Sess......P.487-8
2. Ibid.....P.487
3. Senate Document No. 92. 68th Cong. 1st Sess......P.230

districts. A list of several surveyed by the Secretary of the Interior reveals a range of costs from \$36.00 to \$230.00 per acre with several over \$100.<sup>1</sup> Even after due allowance for the increased estimates the cost should not be regarded as unreasonable when compared with others.

A further method of repaying a part of the cost of the canal is suggested in the proposal to generate electric power at some of the canal drops. R.W. Shoemaker, electrical engineer for the Turlock Irrigation District, believes that from 40,000 to 50,000 horsepower might be developed in this way, an amount which, if sold to Imperial Valley residents, would go a long way toward meeting the construction charges.<sup>2</sup>

It seems most surprising to the writer that most of the attacks on the proposed All-American have been against its engineering feasibility and have almost neglected a very vulnerable point -- its economic justifiability.

The entire project has seemed to take for granted the advisability of present and future extension of irrigation projects in general and of Federal participation in the field in particular. Few voices have been raised in this particular fight against this policy, yet the subject seems to merit a brief examination. It is a matter of common knowledge that there has been widespread dissatisfaction over the results of Reclamation Act and that most of the projects set up have not been financial successes. A suggestion of an awakening public consciousness of this fact is occasionally found in the press.

1. Senate Document No. 92. 68th Cong. 1st Sess......P. 230
2. Engineering News-Record. Nov. 5, 1925.....P. 770

The trouble has seemed to be that the farmers on these projects, knowing that it was the governments money that was at stake, have had a rather light conscience with regard to meeting the annual payments. In fact the government has encountered so much difficulty, and listened to so many tales of woe, that a large part of the obligations have been written off entirely.<sup>1</sup> Even this has done little to solve the situation and land holders still delay and resist payment, still continue to petition the government for extensions of time.

A striking illustration of this was seen a few years ago in the North Platte Project. This district had apparently quite forgotten its obligation to the government, and for three years no charges had been paid. The government had shown great leniency, but had received no cooperation from the settlers. Investigation showed that the project was fully as able to meet its obligations as were many others which were meeting them with a fair degree of regularity. Consequently the government officials felt obliged to insist that proper arrangements for payment be made. So strong was the wave of feeling produced by this order that we are told

"the settlers in the North Platte Reclamation Project on May 27 hanged in effigy Secretary Work of the Interior and Commissioner Mead of the Reclamation Bureau."<sup>2</sup>

All of these difficulties are met in spite of the fact that under the terms of the Reclamation Act the settlers on govern-

1. Engineering News-Record. Dec. 22, 1927.....p.985
2. Engineering News-Record.. June 3, 1926.....p.912



ment projects are required only to pay the principal and maintenance charges, with no interest charges whatever. Of the \$141,500,000 expended by the Federal Government on irrigation districts only a little over \$15,000,000 has been returned and the projects are behind in their annual payments in the amount of over \$5,500,000.<sup>1</sup>

While it is true that much of the laxity in meeting charges has been due to the fact that the land holders do not have the same respect for a government obligation that they have for a private contract, it is also true that the farmers have been handicapped at times by crop failures, pests, and water shortages. Low prices for farm produce much of the time causes additional distress. So we see that the whole situation is one requiring thought and study. The following facts are suggestive.

According to census returns there was a decrease between 1919 and 1924 of 13,000,000 acres of cropland in the United States. In the same period the population increased by 8,000,000 or fully seven percent. Despite the decrease of cropland, however, the total agricultural production increased about thirteen percent, or nearly twice as rapidly as the population. During the same period the farm population suffered a decrease of six percent.<sup>2</sup>

How are we to account for the fact that a decrease in farm land and farm population has not prevented a marked increase in farm production? The answer is to be found, of course, in

1. Hearings on H.R. 5773. 70th Cong. 1st Sess......p.97
2. Newell, F.H. Shall More Land be Reclaimed? Engineering News-Record. May 3, 1928.....p.695

the increased educational facilities afforded by agricultural colleges, experiment stations, etc., and the increased use of labor saving farm machinery. These modern improvements are making it possible for fewer farmers on less land to produce a greater amount of foodstuff than can be disposed of at prices profitable to farmers. One writer points out that the situation is quite analagous to the Industrial Revolution and is working much temporary hardship, concluding that

"With these conditions clear it is difficult to perceive the wisdom of further public land reclamation enterprises.....On the present outlook more Federal reclamation must be declared an unsound policy." 1.

When we attempt to apply this viewpoint to the particular project in Imperial Valley we are met with the question as to whether the crops produced there compete in any way with products raised in other parts of the country. The claim is made on the one hand that

"What is raised in Imperial Valley is peculiar to itself, comes into the market at a time when it does not conflict with any other produce in this country and has no competitive advantage or otherwise with the produce that is raised in any other part of the land." 2.

This view may seem particularly attractive to those of us who are accustomed to eating Imperial Valley lettuce in the winter and berries, cantaloupes and watermelons in the spring, when in less favored sections the seed is not yet in the ground. It is flatly contradicted, however, by Congressman Leatherwood of Utah who claims that at least three-fourths

1. Newell, R.H. Shall More Land be Reclaimed? Engineering News-Record May 3, 1925.....p.695
2. Johnson, Hiram W. Speech in the U.S. Senate. Apr.26,1928.

of the land under cultivation in Imperial Valley in 1927 was devoted to the raising of competitive crops such as alfalfa, barley, cotton, corn and wheat.<sup>1</sup>

The wide divergence of opinion here may be understood in part at least when we realize that there are two ways of arguing the question, first from the standpoint of acreage devoted to each crop and second, from the standpoint of comparative crop values produced annually. While Mr. Leatherwood may have been correct in his figures the table on the opposite page indicates that according to values nearly two-thirds of the crops are assuredly non-competitive. Nearly one-half of the income from the forty crops listed here is derived from cantaloupes and lettuce. It would also seem that the assurance of abundant water supply would tend to increase the production of vegetables at the expense of other types of crops because of their greater financial returns per acre.

We have an illustration of this already in the gradual decline of cotton production. In 1923 it was ranked first in importance among Imperial Valley products.<sup>2</sup> When the movement for the Boulder Canyon Project was first initiated Southern congressmen felt some concern over bringing additional lands under cultivation which might compete with the South in the production of cotton. However, while in 1924 there were 20,000 bales of cotton ginned in Imperial Valley, this had been reduced to 6,000 bales by 1926.<sup>3</sup> By 1928 the combined value

1. Leatherwood, E.O. Minority Views. H.R.5773 70th Cong. 1st. Sess.

2. Soil Survey of Brawley Area. U.S. Dept. Agriculture. .P.715

3. Johnson, Hiram W. Speech in U.S. Senate Apr.26,1928

of cotton and cotton by-products could claim no better than eighth place in importance.<sup>1</sup>

Still another angle of the irrigation question was presented some two years ago by the editor of the Engineering News-Record in an article which evoked warm commendation from President Farrell of Kansas State Agricultural College. His interesting view includes the whole future of irrigation both public and private. Calling attention to the tremendous increase in irrigation development within the last three decades he says,

"As a business enterprise it rests on the tacit assumption that irrigation will continue to be effective and produce undiminished crops for generations to come." 2.

But already there is some evidence that this assumption is insecure. In some localities annual crops are beginning to diminish, from no outward cause. Investigation has disclosed that large quantities of alkali salts have been carried in the irrigation water and deposited at the root zone of the plants. The salts are not assimilable by the crop plants and in the course of time make plant growth impossible.

There is a known practicable solution to this problem. It requires that enough water be applied to the soil to carry the alkali salts downward past the root zone into the subjacent region of under-drainage so that they may be continuously removed.<sup>3</sup> Government experts have realized the value of this

1. See table page 110 Appendix C

2. Engineering News-Record. June 2, 1927.....p.888

3. Ibid.....p.888

method, and declare it the most satisfactory and practical method so far devised.<sup>1.</sup>

Two important requirements are involved in this plan. First, it would call for a tremendous improvement in drainage facilities in most projects. Second, it would call for a cessation of our policy of increasing irrigated areas, perhaps even a reduction of present acreage, in order to provide the enormously increased water supply necessary for its fulfillment.<sup>2.</sup>

Thoughtful consideration of this subject with special reference to Imperial Valley seems the more necessary when we understand the nature of the soil and the water to be placed upon it. In the fall of 1901 the Bureau of Soils, United States Department of Agriculture, made a soil survey of this region and reported the soil so highly alkaline that many crops were decidedly impracticable. It recommended specialization in particular crops which would be suitable to that kind of land, such as sugar beets, sorghum, and date palms.<sup>3.</sup> This was later verified in a second report from the same department, published in 1923, which stated further that unsatisfactory drainage systems were real obstacles to the reclamation of the alkali lands of Imperial Valley.<sup>4.</sup>

All these facts and figures are intended to be merely suggestive, but they serve to throw into relief the whole

1. Soil Survey of the Brawley Area. U.S. Dept. Agriculture. .p. 706
2. Engineering News-Record June 2, 1927.....p. 888
3. Cory, H.T. Imperial Valley and the Salton Sink.....p. 1271
4. Soil Survey of Brawley Area. U.S. Dept. Agriculture.....p. 706

problem of irrigation and reclamation, as well as raise the possibility of honest doubt as to whether any attempt to bring more land in Imperial Valley under irrigation is economically justifiable at the present time.

## DOMESTIC WATER SUPPLY

The price of civic advancement is sometimes very high, not only as estimated in dollars and cents, but also in terms of public opinion. Perhaps no city in the United States is better aware of this fact than Los Angeles. What blood is to the human body, water is to the life of municipalities, and the problem of sufficient water supply for the present and future needs of Los Angeles has been a source of deep concern to that city for many years. It has also been the cause of much hard feeling and misunderstanding between her and other localities.

Only recently the writer was told by a professor who had spent the summer in the eastern part of the United States that there was a strong sentiment in that section against the entire Boulder Canyon Project because of a common opinion that its main purpose was to secure a Federal subsidy for Los Angeles' water supply. Perhaps this is not altogether a surprising reaction when we consider that most of the activity in behalf of the Swing-Johnson bill was centered in the Southern California metropolis.

This attitude has doubtless been furthered by the appearance of magazine articles which have given a mistaken impression of the project. For example, one writer in attempting to show that it would forever impede the development of Arizona, states that owing to certain climatic and soil conditions water will really go further in Arizona than in California,

and further that

"It can also be done more cheaply in Arizona than by lifting the water out of its natural basin over the divide onto the California coastal plain." 1.

The only inference one can draw from this statement is that the author believed, or wished her readers to believe, that this water so lifted "out of its natural basin" was to be used for purposes of irrigation when in reality nothing could be farther from the truth. This kind of loose writing has given to many quite a false impression of the purpose of the project.

From the time of the establishment of Los Angeles as a Spanish pueblo in 1787 to the year 1906 the bulk of the city's domestic water was secured from the Los Angeles River.<sup>2</sup> By 1904 the pressure of increasing population began to be felt and additional water supply seen to be necessary. No nearby streams of sufficient magnitude were available, hence it was found necessary to reach some 250 miles northward into the Sierra Nevada Mountains and tap the Owens River. It was an ambitious undertaking from an engineering standpoint. It required the construction of a 250 mile aqueduct capable of carrying 400 second-feet of water. Yet it was brought to successful completion within the time allowed and within the original cost estimate of \$24,000,000.<sup>3</sup>

It was confidently believed that the completion of this

1. Austin, Mary, The Colorado River Controversy, The Nation  
Nov. 9, 1927.....p.510
2. Mulholland, W. Water from the Colorado The Community  
Builder Mar. 1928.....p.23
3. Ibid.....p.23



project would solve the water needs of Los Angeles for at least fifty years, as it was sufficient for the needs of 2,000,000 people. But certain developments could not be foreseen. At the time of the inception of the project the population of Los Angeles was 160,000.<sup>1</sup> Today only a quarter of a century later the city approaches her second million. Another factor not given due consideration was the variability of rainfall in the Owens Valley region. In some years it amounts to only two or three inches, providing almost no run-off, and in one year the amount of water available for the aqueduct decreased from 400 second feet to 270 second feet.<sup>2</sup> It is this unreliability, rather than the total amount available over a period of years, that is the cause of most concern.

The question naturally arises as to the possibility of drawing additional quantities from the streams and underground sources near Los Angeles. But this gives rise to another problem -- a possible shortage of the amount required for agricultural needs. Mr. Burdett Moody believes that

"the most marked feature of the present water supply situation is the serious encroachment upon the present needs of agricultural supply by urban and suburban development. The present tendency, if continued, will automatically stop the growth of any community, dependent as it is upon the neighboring agricultural development."

1. Hearings on H. R. 2903, 70th Congress 1st Session....p.97
2. Hearings on H. R. 2903, 68th Congress 1st Session..p.98,99
3. Transactions of the Commonwealth Club of California  
Apr. 13, 1926.....p.58

It would seem extremely doubtful then if Los Angeles would gain anything by taking more water from the adjacent territory.

The possibility of reaching farther north has also been suggested, but this is generally recognized to be inadvisable, as it might encroach too much on the future needs of central California.

The experiences of Los Angeles have been such as to make her somewhat wary of encroaching on the needs of other sections, either with or without legal justification. The farmers of Owens Valley have long regarded themselves as victims of Los Angeles' greed. They feel that the water of the Owens River is rightfully theirs and innumerable attempts have been made to dynamite the aqueduct. On one occasion over 300 feet of siphon was blown out.<sup>1</sup> So serious did this situation become that in 1927 the city of Los Angeles took out insurance on the structure amounting to \$7,500,000, covering possible damage due to "explosion, riot, and civil commotion".<sup>2</sup> A more recent development reported in the press is the plan whereby the city of Los Angeles is to purchase outright the entire Owens Valley including the towns of Bishop, Big Pine, Independence and Lone Pine, along with all remaining water rights in that region. The transaction will involve about

1. Engineering News-Record, June 2, 1927.....p.915
2. Ibid......, Sept. 15, 1927.....p.413

\$8,000,000.<sup>1</sup> It is thought that this will settle the present difficulties as well as provide what additional water is needed till Colorado River water is available.

The present plan is to take water from the Colorado River near the town of Blythe, California, which is about 150 miles below the site of the Black Canyon Dam. The water will be carried to Los Angeles and other coastal plain cities through an aqueduct about 260 miles long. This must pass over a range of mountains and will require a pump lift at one point of 1400 feet. The estimated construction cost is about \$150,000,000.<sup>2</sup>

That the people of the southern metropolis and surrounding communities are tremendously in earnest over the proposed plan is evidenced by the energetic and business like way they have launched their program. In June, 1924, official filings were made on 1500 second-feet of water from the Colorado. Due to the fact that all of the present low flow of the river is appropriated, it was possible to file only upon flood waters to be diverted when a storage dam is provided.<sup>3</sup> The next step was taken in 1925 when Los Angeles voted a bond issue of \$2,000,000 to be used in making preliminary surveys and investigations of future needs.<sup>4</sup> The third step was the actual launching of the necessary surveys and most of the funds

1. Stockton Evening Record, Feb. 27, 1928
2. Majority Report, S. 728, 70th Congress 1st Session...p.25
3. Van Norman and Bayley, "Colorado River and Los Angeles Aqueduct", Engineering News-Record, May 31, 1928..p.851
4. Ibid.....p.850

provided by the bond issue have already been expended on this work. Over 18,000 square miles of territory have been surveyed and mapped, most of it having never before been touched by a surveyors instrument.<sup>1.</sup>

Los Angeles was not alone in recognizing the need for other sources of water. Other municipalities were feeling the shortage, but state laws made it impossible for them to join with Los Angeles in promoting the project. In response to the demand arising out of this situation the California legislature passed the Metropolitan Water District Act in 1927 which made it possible for

"four or more municipalities, whether contiguous or not, to join in the formation of a metropolitan water district for the purpose of development, storage, conservation and distribution of water for domestic purposes." <sup>2.</sup>

Any one city may initiate such a movement, others joining in if they wish.

A movement was at once started to form such a district in Southern California, which was done by the vote of the people on November 6, 1928. At the present time it comprises eleven cities situated in three counties, and several others are expected to join in due time.<sup>3.</sup> When the purpose is finally achieved the cost of the project will be distributed among the various cities of the district in proportion to their assessed valuation.

1. Mulholland W. "Water from the Colorado", The Community Builder, Mar. 1928.....p.25
2. Van Norman and Bayley, "Colorado River - Los Angeles Aqueduct", Engineering News-Record, May 31, 1928..p.851
3. See page 109 Appendix B

Certain questions have been raised with regard to this ambitious program which it may be well to touch upon. The first of these has to do with the quality of the water which will thus be supplied, the second with the economic soundness of the project.

It has been suggested that there is danger of the water being contaminated. This is not regarded seriously as it is thought that the high rate of discharge of the Colorado River and the sparsely settled area which it drains makes this risk less than from any other available source.

A somewhat more serious problem is that of silt. It is true that the dam is designed to act as a settling basin and thus desilt the stream. But for a considerable time there will go on the process of scouring the stream bed below the dam, and this silt must be cared for in some way.

Just how this will be done is yet uncertain. Various methods are under consideration, the most reasonable of which is the proposal take the water from infiltration ditches or galleries sunk in coarse gravel some distance away from the river.<sup>1</sup>

The economic soundness of the project has been most persistently attacked with the charges that there is no real need for increasing the supply and that such future increases as are found necessary may be amply provided for by additional supplies from Mono Basin and Owens Valley.<sup>2</sup> Space does not

1. "Hearings on Boulder Dam at Los Angeles", Engineering News - Record, Nov. 5, 1925.....p.770
2. Douglas, L. W. Minority Views, H. R. 5773, 70th Congress 1st Session.....p.8

permit entrance into this controversy other than to state that it would seem very strange that southern California municipalities would calmly plan the expenditure of \$150,000,000 for such a project unless thoroughly convinced that the exigencies of the occasion require it.

Proponents of the project urge it not alone as a necessity to southern California cities, but also as a distinct financial advantage in the construction of the Boulder Dam. This advantage would accrue in two ways.

First, it would provide a revenue to the government through the sale of the 1500 second feet of water required by the district. The district would contract for the storage of a stipulated amount and its delivery at a certain point on the river.

Second, it would materially assist in the all-important problem of finding a market for the power to be generated at the dam. The route which has been selected for the aqueduct extends from the river near Blythe westward over Shavers summit - a lift of 1400 feet - thence by gravity to its destination. This 1400 foot elevation is to be surmounted by five successive pump lifts. This will require, it is estimated, 278,247 h.p. of electrical energy, thus absorbing at least one half of the total output.<sup>1</sup> Not all this will be needed at once, of course, as the full 1500 second-feet will not be needed for several years. It is estimated that when the aqueduct is running at full capacity the total annual pumping cost

1. Van Norman and Bayley, "Colorado River - Los Angeles Aqueduct", Engineering News-Record, May 31, 1928...p.853

will be over \$8,000,000.<sup>1</sup>.

It would seem, then, that the project is not to be regarded as a particularly vicious or selfish enterprise. It will be paid for by its beneficiaries and the revenue thus provided will greatly assist in the repayment of the cost of the dam.

1. Van Norman and Bayley, "Colorado River - Los Angeles Aqueduct", Engineering News-Record, May 31, 1928..p.853

## POWER DEVELOPMENT

It may be taken as almost axiomatic that any project conceived for the purpose of irrigation, reclamation, flood control, power or other purpose must, in the last analysis, be economically sound if its permanent stability is to be assured. The proposed Boulder Dam is, and should be, no exception to this rule. Its only justification must be found in the results accomplished.

It is quite apparent that no large income is to be expected from the sale of water for domestic and irrigation purposes. It is to the power generated at the dam that we must look for revenue to pay the most of the costs involved. It is this fact that has made the problem of power development of such tremendous importance. It has been chosen by the opponents of the project as the most vulnerable point of attack and they have succeeded in making it the central point in the discussion.

The physical features of the Colorado River are, as we have seen, particularly favorable for the development of hydro-electric power. The entire fall of the river is nearly 4,000 feet and between the Green River in Utah and the Gulf there is a fall of some 4,000 feet. The most careful and exhaustive survey yet made of the power possibilities was reported in 1925 by Mr. E. C. Larue of the United States Geological Survey. In his report are listed thirteen potential power sites below Green River, which with the water supply available



in 1922 would be capable of generating 4,350,000 continuous horsepower.<sup>1</sup> Allowing for the possible withdrawal of a reasonable amount of water for the demands of the upper basin, this figure would be reduced to 3,420,000 continuous, or 5,743,000 installed horsepower.<sup>2</sup> Another estimate, perhaps based on a less careful study than that of Mr. Larue, places the total amount of energy available in the entire upper basin at 7,000,000 continuous horsepower. At the time this estimate was made in 1925 it was equal to one-half the entire central station output in the United States.<sup>3</sup>

It is interesting and instructive to compare the Colorado with other great rivers in the United States with regard to power possibilities. We have noted that for a distance of some 300 miles it has a drop of seven and one-half feet per mile, while in its entire course the drop is over eight feet per mile. The Mississippi River, on the other hand, from Cape Girardeau to the Gulf of Mexico drops only eight inches per mile. The Tennessee River, reputed to have great possibilities for power development, has a fall of only about 500 feet between Knoxville and Paducah, a distance of some 700 miles.<sup>4</sup>

The question of immediate importance in this study is the possibility of power development offered by the proposed

1. Water Supply Paper No. 556.....p.10
2. Ibid.....p.10
3. Engineering News-Record, Jan. 8, 1925.....p.59
4. James, H. F. "Geographic Features of the Colorado River and Basin", Annals of the American Academy, Jan. 1928.....p. 106

Boulder Canyon Dam. According to plans and estimates of the Reclamation Bureau, a plant or plants will be installed capable of generating 1,000,000 horsepower which when used on a 55 percent load factor will yield about 550,000 continuous horsepower.<sup>1</sup> This estimate has been generally accepted. It is through the sale of this power that the most of the cost of the project must be amortized. Whether or not the proposal is economically sound depends upon a variety of factors. It would be quite useless to attempt to follow the question through in all of its many ramifications. Volumes of data have been compiled and a great mass of testimony presented before various committees. What follows here is a necessarily arbitrary outline of the main issues and problems, together with the more pertinent facts brought out in regard to them and personal estimates of those issues.

It is frequently urged that the project is illogical and unsound because the purposes of flood control and power development oppose each other and cannot be satisfactorily served with the same dam. Power dams must be kept full to provide the necessary head for generation, while flood control dams must be kept empty to provide a basin for excess water in flood season. One writer quotes the noted engineer, Arthur E. Morgan, in support of this contention.<sup>2</sup> He does not, however, give the full text of Mr. Morgan's remarks in the

1. Majority Report, H. R. 5773, 70th Congress 1st Session .....p.23
2. James, H. "Geographic Factors of the Colorado River and Basin," Annals of the American Academy, Jan. 1928..p.106

article to which he refers which are that:

"Except for rare cases, such as the proposed Boulder Dam on the Colorado River, where vast storage capacity is available in an unsettled country, storage for flood control and power development are in striking conflict." 1.

The great height and storage capacity of the proposed dam should make it possible to provide sufficient head for power and still reserve enough space to care for the seasonal floods.

A second problem which has loomed very large is the probable cost of the project. There has been a wide difference of opinion here, and a tendency to question the reliability of estimates made by government engineers. The original cost estimate was \$125,000,000 and the plan of financing indicated the possibility of amortization within twenty-five years.<sup>2</sup> This was an altogether beautiful and inviting picture of the economic soundness of the project.

There were some, however, who were not at all sure that these estimates were sound. Congressman Douglas of Arizona has very pertinently called attention to the fact that estimates made by the Reclamation Bureau have in the past been very unreliable. Twenty-seven projects undertaken by them in the last twenty-one years have cost approximately sixty percent more than the original estimates.<sup>3</sup> He goes further

1. Morgan, Arthur E. "The Mississippi", Atlantic Monthly, Nov. 1927.....p.668
2. Annals of the American Academy, Jan. 1928.....p.121
3. Douglas, L. W. Minority Views, H. R. 5773, 70th Congress 1st Session.....p.24

and quotes the Secretary of the Interior to the effect that estimated construction costs of government reclamation projects have generally been below final expenditures. Hence, it is not surprising that the bill as finally passed considerably altered the original estimates and made the authorized expenditures conform to the recommendations of the board of engineers and geologists which reported to Congress in December, 1928.

As has been indicated, the present plan does not call for the payment of the All-American canal from power revenues, and \$25,000,000 of the appropriation is allocated to flood control, to be repaid only if excess revenues are available. This leaves the sum of \$101,500,000 to be amortized within fifty years from the sale of power. Hence, we see that although the present estimated costs are in excess of the original, the amount which must be paid out of power revenues is materially reduced. The question now becomes one of whether the power developed will yield sufficient return to amortize even this amount.

It may be readily seen that the amount of revenue obtained will be dependent upon a number of factors, of which the more important are (a) the cost of production, including cost of dam, power site, maintenance charges, etc., (b) cost of transmission to the market, (c) the ability to meet the competition of electric power generated by other means and (d) the availability of a market.

As might be expected in so technical a field, relatively few careful, well-worked out estimates have been made of the cost of power production. Only two such have come to the

writer's attention which are presented here for comparison. One is from Professor W. F. Durand of Stanford University and is found in his report as special advisor to the Secretary of the Interior. The other is presented by a board of engineers engaged by the Nevada Colorado River Commission as summarized by George W. Malone, state engineer of Nevada. For the sake of convenience, we shall refer to the latter as Mr. Malone's figures.

Professor Durand's estimate was that a sale price of 2.2 mills per kilowatt-hour would be sufficient to retire the entire original estimated cost of \$125,000,000 within 30 years.<sup>1</sup> Under certain conditions, such as extending the amortization period, he believed this might even be reduced to 2.0 mills while a sale price of 2.5 mills would provide a large margin for contingencies or permit a shortening of the amortization period.

Mr. Malone's figure, arrived at in an entirely different survey, is strikingly similar. Based on the cost estimate of \$125,000,000 to be amortized in a forty-year period, he places the cost at 2.14 mills per kilowatt hour.<sup>2</sup> This is approximately the same as Mr. Durand's figure of 2.2 mills when the difference in time is considered.

Next we must consider the cost of transmission to market, and the actual cost at the receiving station. With a sale

1. Hearings on H. R. 5773, 70th Congress 1st Session. p.497
2. Ibid.....p.552

price of 2.2 mills, and allowing for 12 percent loss in transmission, Professor Durand places the cost at the receiving station at 4.10 mills per kilowatt-hour.<sup>1</sup> The estimate of Malone is somewhat lower, being 3.75 mills.<sup>2</sup>

There is some difference of opinion among experts as to the necessity of supplying a steam power reserve to care for unforeseen accidents which would result in non-delivery. If such a reserve were provided it would add about .50 mills to the above estimates. It may be well to add that these figures are based on the assumption of a transmission line about 300 miles in length, and costing \$50,000,000 which sum would include interest during construction.<sup>3</sup> The question now becomes one of how these figures for the cost of producing hydro-electric power at Boulder Dam and delivering it to the consumer compare with the cost of power supplied from other sources.

One of the very interesting developments of recent years has been the almost phenomenal reduction in the cost of producing steam power. This has been due to increased efficiency, particularly with regard to the conservation of heat energy used in production. For example, it is said that one southern California plant almost cut the amount of heat energy used in half within a period of two years, 1924-26.<sup>4</sup> It is claimed

1. Hearings on H.R. 5773, 70th Congress 1st Session...p.498
2. Ibid.....p.557
3. Ibid.....p.555
4. Ibid.....p.100

by some that it is now possible to produce steam power more cheaply than hydro-electric power could be delivered from Boulder Dam. It has been said that the Southern California Edison Company now produces steam power at its Long Beach Plant No. 2 at a cost of 4.17 mills per kilowatt-hour.<sup>1</sup>

It is difficult for one, other than an expert, to know just how to evaluate such claims. Mr. Malone estimates the present cost of steam power production at 4.89 mills per kilowatt-hour.<sup>2</sup> This is somewhat higher than the estimated cost of Boulder Canyon power. The margin becomes even greater when we consider that the Boulder Canyon figures were based on a sum of \$125,000,000 to be amortized, which is now reduced to \$101,500,000. When this is taken into account and the fact that the amortization period is fifty years rather than thirty or forty, it would seem logical to believe that hydro-electric power will be well able to compete with steam power.

An additional factor seems worthy of consideration in this connection. The estimates of steam power production have generally been made on a basis of cost of fuel oil of \$1.00 to \$1.50 per barrel. Some companies are using oil which cost them on contract some years ago only about \$.70 or \$.80 per barrel.<sup>3</sup> But it would not be safe to assume that future supplies of oil will be available at any such

1. Hearings on H.R. 5773, 70th Congress 1st Session, p.100
2. Ibid.....p.557
3. Ibid.....p.499

price. We are reaching the place where conservation of oil reserves is being regarded as a prime necessity. At least one great engineer, President Hoover, gave actual expression to this conviction when he announced immediately after his inauguration that there would be absolutely no leases of public oil lands during his administration except such as were made mandatory by Congress.<sup>1</sup> Press reports also advise us of a move on the part of the big oil companies to restrict the 1929 output to the amount produced in 1928. All these things indicate that the trend of oil prices is likely to be upward, and cause, as a result, a corresponding increase in the cost of steam power.

There is one other consideration of deep importance in connection with the generation of electric power, and that is the availability of a market. Two questions arise out of this: (a) Is there a market sufficient to absorb the entire output? (b) Can this enormous supply come into the market without causing serious economic disturbance, that is, without causing some existing steam plants to become idle?

In order to make the cost reasonable, it is thought that the market must be found within a radius of 300 miles. Arizona, Nevada, and California are the likely beneficiaries. How much Nevada will require is problematical, but that she expects to use some is evidenced by her request to be allowed the privilege of withdrawing certain blocks of power as

1. Stockton Record, March 12, 1929.....



they are needed.<sup>1</sup> Arizona does not appear likely to become a heavy consumer for a long time to come. This was looked upon as a likely field a few years ago because of the amount of power used in smelting copper. Since that time, however, improvements in mining machinery have enabled the mines to generate power very cheaply by using waste heat.<sup>2</sup>

The bulk of the power bill must ultimately be met by the residents of Southern California. Several promising markets are to be found there though the amount possible for some of them to absorb is a matter of pure speculation. Much depends on the growth of industries, the extensive use of electrically driven pumps for farm irrigation and other similar activities.

One field, which has attracted the interest of many, is that of possible electrification of railroads. In recent years railroad electrification has created considerable interest among engineers, and the movement has made some headway in certain parts of the United States. While the possibilities here are too remote to be counted on, they may be envisioned by the knowledge that there are six trunk railroad lines in operation which could be conveniently supplied with power from this source. In 1916 it was estimated that in this way alone a market might be supplied for a half-million horsepower of electrical energy.<sup>3</sup>

One market that seems fairly well assured will be for the amount needed to lift the water in the Colorado River--

1. Hearings on H.R. 5773 70th Cong. 1st Sess......P.559
2. Ibid......P.98
3. Water Supply Paper......No.395.....P.184

Los Angeles Aqueduct over the 1400-foot range of mountains. It has already been indicated that this alone may absorb half the out put when the water requirements of the Metropolitan Water District are sufficient to demand the full flow of 1500 second feet. How much will be immediately required it is of course, impossible to say.

A much more important question is how rapid an increase may be expected in the regular industrial and domestic needs. Mr. Malone states that

"Records for past years show that the rate of increase in firm horsepower in the southwestern power markets has been at the rate of about 75,000 horsepower per year." 1.

It would be easy to assume from this that the full amount of power would be used within a very short time. There seems to be some danger in such an assumption, however. It cannot safely be taken for granted that Southern California will show the same phenomenal growth in the next decade that it has in the last. Somewhere there may be a vanishing point in this rate of increase, or, shall we say, a point of saturation. Even allowing for a considerable diminution, however, there should in the natural course of events be sufficient increase to bring all power into use within a reasonable period.

In the meantime, there seems to be no need for fear of a possible derangement of the power market. It is not proposed to throw the entire amount of 550,000 H.P. onto the market at one time. The plan is one of gradual development,

1. Hearings on H.R. 5773. 70th Cong. 1st Sess......P.554

the equipment to be installed in units of about 100,000 H.P.<sup>1.</sup>

Some years ago a very careful survey of present and probable future power needs was made by Mr. L.S. Ready, Chief Engineer of the State Railroad Commission of California and Mr. H.G. Bailey, consulting engineer and former power administrator of the state. Both of these experts agreed that the power to be produced at Boulder Dam could be put to use without creating any economic disturbance which would affect our present power generating companies.<sup>2.</sup>

Summarizing, there would seem to be ample reason to believe that sufficient power may be generated at Boulder Dam and marketed in the southwest to assure the financial soundness of the project. Not only do the facts and figures indicate such stability, but the public treasury is further protected by the provision in the Boulder Canyon Project Act requiring the Secretary of the Interior to "make provision for revenues, by contract or otherwise, adequate in his judgment to pay all expenses" before any money can be appropriated for the dam or All-American Canal.

1. Majority Report. H.R. 5773. 70th Cong. 1st Sess......P.21
2. Transactions of the Commonwealth Club of California  
April 13, 1926.....P.61

## STATES RIGHTS vs FEDERAL RIGHTS

There comes at this point a very strong temptation to deviate from the original purpose of this paper and enter into the discussion of a phase of the question which is more political than economic in its aspects. Indeed, it seems almost necessary to touch in a brief way on the question of states rights as opposed to those of the Federal Government.

The question as to the proper limits to governmental activity in the field of business has always been a pressing one in American life. Every attempt of the government to enter actively into the development of a particular state or section has been met by the most unrelenting opposition of those who believe in "state sovereignty." It is not surprising that the right of the Federal government to carry out the Boulder Canyon Project should meet this same opposition.

Nothing could be gained here by a protracted discussion of the legal aspects of the question. That is the task of lawyers, and the courts may yet be called upon to enter into the controversy. There are, however, certain economic factors to be considered, which call for comment, and which seem to commend this particular work to the Federal government.

First, we must consider that the Colorado is an interstate stream and if each state is to be considered as owning the bed of the river within that state, the matter of stream development for purposes of flood control and irrigation is likely to be very complicated and costly. Further complications

may arise from the fact the stream is international, and cause the individual states considerable embarrassment.

Generally speaking, however, the opposition has centered on the purpose of the government to generate electric power. This feature has been strenuously opposed by large business enterprises, especially those engaged in power production.

It should be called to mind that this does not establish a precedent in this particular field. Already power plants have been installed on 13 Federal reclamation projects. In 1925 these works, which represent an investment of \$6,007,649 yielded gross earnings of \$1,067,135 and net earnings of \$442,619, a return of 7 percent on the investment.<sup>1</sup>

One important reason for government construction of the power plant at Boulder Dam is that it would make for a fairer and more efficient system. Only a limited number of sites for power plants will be available, and under a plan involving the allocation of power privileges some would secure much better locations than others. Physical limitations are such as to make some believe that one good site will be available and the private company securing it would have a virtual monopoly, thus giving it an unfair competitive advantage. Controversies would be sure to arise between applicants, creating administrative problems very difficult of fair solution.<sup>2</sup> Even if room permitted the construction of more than one plant there would be a duplication of equipment and

1. Engineering News-Record...Aug. 5, 1926.....P. 215

2. The New Reclamation Era....Feb. 1926.....P. 21

consequent expense unnecessary under a unified plan.

The case has been admirably summed up by former Secretary of the Interior Hubert Work. Pointing out the interstate and international aspects involved, the great diversity of interests to be served such as agricultural development, flood control, and industrial benefits from cheap power he concludes that

"No agency but the Federal government should be intrusted with the protection of rights or distribution of opportunities. All uses can be coordinated and the fullest benefits realized only by their centralized control." 1.

It seems pertinent to suggest that perhaps the question of states rights has been pushed forward into a position of prominence quite out of proportion to its real importance. The viewpoint of Herbert Hoover expressed some years ago, seems to possess great common sense, even if it does fail to meet the approval of private business men and states rights politicians:

"The question of states rights is raised on the one hand, whether it can be made to hold in our American life is problematical. One thing is certain. There is no purpose in holding to an academic principle when it delays development of so great a project and endangers the lives of 50,000 people." 2.

1. New Reclamation Era Feb. 1926.....P. 20-21
2. From an Address before Colorado River Commission.  
Denver. April 1, 1922

## STATE ATTITUDES TOWARD THE PROJECT

It is interesting and necessary to a proper understanding of the controversy that we call attention here to the attitudes of the various states upon the question. It has seemed to the writer that the outstanding tragedy of the entire discussion has been the unwillingness on the part of the representatives of the various states to credit others with motives as honest as their own. There has always been present a current of bitterness, born of mistrust and jealousy, a total disinclination to even attempt to see the problem from the viewpoint of the other man, and to make mutual concessions for the good of all. It is the thing which, even up the time this is written, has succeeded in blocking every effort to reach a harmonious agreement. It should assist in understanding the situation if we study here the viewpoints of the states toward the compact and the Swing-Johnson Bill.

The attitude of the state of Arizona toward the project has been ably set forth by a number of individuals, among whom the most representative have been former Governor Hunt, Congressman Douglas and Senator Hayden of that state. Without doubt, however, the most authoritative and succinct statement was that of Mr. Mulford Winsor, testifying in behalf of the Colorado River Commission of Arizona before the House Committee on Irrigation and Reclamation. He listed nine different reasons for Arizona's protest against the

passage of the Swing-Johnson Bill, as follows:<sup>1</sup>.

1. Because it would deny the right of regulation and control by any state within its boundaries of the appropriation, use and distribution of water.
2. Because its effect would be to deprive Arizona of water necessary for her future development and growth, and for the reclamation of her arid lands.
3. Because it would usurp and confiscate, for the practically sole and exclusive benefit of California, resources of great value belonging to the States of Nevada and Arizona, without compensation therefor.
4. Because it would predetermine, or seriously influence, the plan of development of the Colorado River within Arizona, without that State's consent.
5. Because in the absence of a binding treaty with Mexico, or of effective notice to Mexico, it would create a storage and effect a stabilization of the river's floods, which would quickly be taken advantage of by owner's of land in Mexico to increase their irrigated acreage, and thus establish what might be regarded as a moral right to the continued use of the water so applied to beneficial use, to the detriment of development in the United States.
6. Because, while precluding the states of Arizona and Nevada from securing the benefit of natural resources belonging to them, it would burden the power developed through the use of those resources to subsidize a California reclamation project.
7. Because it would still further discriminate against States by giving to California districts canals and power plants developed in them while withholding from the States of Arizona and Nevada the ownership of dams built within their borders by the Federal Government.
8. Because, violating as it does rights vital to the States whose resources it imperils and appropriates, and probably violating the Constitution of the United States, its passage could only result in endless litigation and the consequent deferment of Colorado River development.
9. Because, by making the Federal government party to a compact affecting the interests of the seven states upon its acceptance by six,---it would in

1. Hearings on H.R. 5773, 70th Cong. 1st Sess......p.50-52



effect impose a boycott upon such as might not subscribe to the agreement, and particularly upon the State of Arizona, thereby making of it both a confiscatory and coercive measure!

This imposing list might, for all practical purposes, be sifted down to two impelling causes. First, that California is ready to immediately appropriate and use a large amount of water, while Arizona will not be ready for any considerable amount for years to come. Hence in the absence of any definite agreement as to water allocation, California might put to beneficial use the most of the water allotted to the lower basin and Arizona's development forever impeded. Second, Arizona feels that she should secure some of the revenues to accrue from the sale of power, and that this will not likely be possible, at least in such measure under the ownership of the national government as it would in case of state or private development. It is around these issues that the battle has been fought.

There is no room for doubt, of course, as to the attitude of California toward the project, and this very fact has tended to make some wonder why she would consent to the proposed six-state ratification of the compact only with reservations. California's attitude here was perhaps best described by Senator Johnson in the following words:

"With Arizona out of the compact, however, it followed that California's approval on this new basis effectively made her the guarantor of the obligation of the whole lower basin. Under this plan any encroachment by Arizona upon the water allotted to the upper basin states would have to be made up by California. With Arizona refusing to agree to any limitations upon her use of the water of the river, California was forced to take the position that she could not safely assume this new and additional obligation for the benefit

of the upper states without assurance of large storage..<sup>1</sup>

Hence California's insistence that Congress provide such large storage before assenting to a six-state agreement.

The state of Nevada has consistently maintained a friendly, though critical attitude toward the project. It has been recognized that the proposed dam will benefit her in two ways:

1. By making it possible to irrigate 80,000 acres of land by the water so stored.
2. That the power developed at the dam may be of real help in the industrial life of the southern section of the state.<sup>2</sup>

A number of interesting proposals indicative of Nevada's attitude have been suggested by her to the Senate Committee on Irrigation and Reclamation. The most important of these is that charges for power be not fixed at the lowest possible price, but on the basis of competitive bidding and that after the returns had been sufficient to repay the government all subsequent revenues should accrue to the state.<sup>3</sup> These suggestions and criticisms have always been given in a most friendly manner and probably the enthusiasm of the citizenry over the project has been exceeded only by that found in California.

The attitude of the State of Wyoming toward Colorado River development, as expressed by Governor Frank C. Emerson

1. Majority Report S.728 70th Cong. 1st Sess......P.14
2. Balzar, Gov.F.B. "Nevada and the Colorado" The Community Builder Mar.1928.....P.40
3. Ibid.....P.38

in a personal letter to the writer, is very interesting, especially in the light of that states previous experience with the State of Colorado over water rights. It will be remembered that these states became involved in a dispute over water rights in an interstate stream, Wyoming claiming priority of right by virtue of the fact that the stream had its rise in that state. After a number of years spent in litigation, a decision was handed down by the Supreme Court of the United States on June 5, 1922, stating that as between two prior appropriation states, water rights on an interstate stream would be determined upon the basis of prior use irrespective of state lines.<sup>1</sup> That this lesson was not lost on Governor Emerson is made quite evident by the following excerpts from his letter stating Wyoming's attitude toward Colorado River development:

"The Upper Basin States are properly concerned over having a definite agreement between the states of the Colorado River Basin before the great project, which might establish priority of rights to most of the flow of the river, be placed in effect before the work proceed. Careful studies of the flow of the Colorado River system have convinced at least most people that there is sufficient water for all, if proper conservation methods are employed. Wyoming has had a lesson upon another great interstate stream in this state wherein we find early development in a state below us has caused an embargo upon additional developments from this river to which we know we are justly entitled. This situation of today is due to a lack of agreement with the other state prior to development. We do not want to see this situation repeated upon the Colorado River. Therefore our insistence that the Colorado River Compact, or other form of definite agreement, be reached between the states before the project be constructed."<sup>2</sup>

1. Olson, R.L. "Legal Problems in Colorado River Development" Annals of the American Academy. Jan. 1928. .... P. 109
2. Personal Letter. Sept. 28, 1928

This attitude as expressed by Governor Emerson may safely be taken as indicative of the sentiment of all of the upper basin states. The completion of a storage dam in advance of the signing of a compact allocating water rights would make it possible for the lower basin states to establish priority rights on most of the flow of the river, so that the more slowly developing states to the north would in the course of a few years find nothing left for them.

It was this consideration which induced Utah, after having agreed to a seven state compact, to refuse concurrence in the six-state treaty. As Governor Dern explained:

"It does not afford us full protection because we are not protected against Arizona...She is bound by no compact and has renounced no rights that she might in the future acquire through beneficial use. She is therefore under no restraint but can help herself freely to the waters of the river, and by so doing she may take water that, by the terms of the compact belongs to the Upper Basin." 1.

But the states in the upper basin have a very important reason for wishing differences over the compact settled and a storage dam constructed. The natural low flow of the Colorado river was fully appropriated by irrigations of the Imperial Valley and other places in the lower basin over twenty years ago. Later appropriations included really more than the natural flow, so that serious shortages have occurred during several years. Now, at the present time there are several projects in the upper basin taking water from the Colorado whose appropriations are subsequent to those of Imperial Valley. In case of continued shortages there is a real danger that the Imperial Valley users will seek to restrain the

1. Address before Western Division of Chamber of Commerce of U.S. Colorado Springs. Dec. 7, 1926.

use of water on these projects until their own needs are met. This situation is proving a handicap to any further development among the states of the Upper Basin.<sup>1</sup>.

That the desires of most of the states were met in the final drafting bill is evident by the expressions of approval coming from them. Even Utah has again voted to accept the terms of the Compact. The desire of Nevada and Arizona to participate in the revenue accruing from the sale of power has been satisfied. The one remaining crease to be ironed out is the matter of water allocation between Arizona and California. Up to the time this is written all efforts along this line have failed.

1. Davis, A.P. "The Colorado River Surveys" The Community Builder. Mar. 1928.....p.19

## SUMMARY AND CONCLUSIONS

The Boulder Canyon Project is fundamentally designed to serve this four-fold purpose of flood-control, irrigation, domestic water supply and power development. It would be a mistake to give undue prominence to any one of these at the expense of the others. No single one could justify the expenditure of such an enormous sum of money. Any one purpose might be served at less expense. The important thing to see is that all these objects may here by realized in a single project at less expense than in a different project for each purpose. At the same time it offers the opportunity of beginning a unified program of development under the supervision of the national government, thus forestalling the unorganized and haphazard development which would be sure to follow state or private control.

Throughout much of the discussion in Congressional Committees and in the press there has been a tendency to obscure the real economic issues by the injection of more or less irrelevant material of a political nature. Both proponents and opponents of the project have been guilty of this. Charges of the existence of a "power trust lobby" have been countered with charges of activity by a "Boulder Dam lobby", each party conveniently ignoring the fact that any group has a perfectly legitimate right to maintain such a lobby to further their interests. Many of the project's opponents would have profited by its defeat, and likewise, many of its friends expect to profit by its success. Its merit should be judged

quite apart from such questions as these.

It will be noted that the text of the act enumerates one other economic advantage to be achieved which has been ignored in this study. It is stated that it is designed to "improve navigation". To the writer it seems utterly futile to attempt to justify the project on such a basis. There was once a time when a small amount of navigation by light craft was carried on in the Colorado River. Today it is practically non-existent. It is largely, however, on the basis of the technical navigability of the river that the national government claims legal jurisdiction of the stream. It was for the purpose of maintaining this claim that the clause was incorporated in the bill. Curiously enough, this step was taken as a precaution, while Congress boldly voted to accept the Colorado Compact which specifies that the Colorado River is non-navigable!

Taken as a whole the project seems to present a unique combination of the elements of urgency, utilization of benefits, and economic feasibility. Carried to fruition it will mean that never again will it be possible to say, as one writer said only a few years ago, that "the chief merit of the Colorado is not utility, but grandeur." <sup>1</sup>.

1. Faris, John T. The Romance of the Rivers.....p.236

## BIBLIOGRAPHY

United States Government Documents, Congressional Reports and Speeches.

- Ashurst, Henry F. Waters of the Colorado River. Speech in the U.S. Senate. Aug. 15, 1921. Congressional Record, 67th Cong. 1st Sess. V. 61, No. 99.
- Fortier, S. and Blaney, H.F. "Silt in the Colorado River and its Relation to Irrigation." Technical Bulletin No. 67. U.S. Dept. of Agriculture, Washington, D.C. U.S. Government Printing Office, 1928.
- Hunt, Geo. W.P. Colorado River Problems. Letter from Governor Hunt (Arizona) to Senator Ashurst, Feb. 3, 1926. Congressional Record. 69th Cong. 1st Sess. V. 67, No. 47.
- Johnson, Hiram W. Boulder Canyon on Dam Project. Speech in the U.S. Senate, Apr. 26, 1928. U.S. Government Printing Office. Washington, 1928.
- Johnson, Hiram W. Boulder Canyon Dam Project. Speech in the U.S. Senate, May 22, 1928. U.S. Government Printing Office, Washington, 1928.
- United States Congress. House. Committee on Irrigation and Reclamation. Protection and development of the lower Colorado river basin. Hearings on H.R. 5773. 70th Cong. 1st Sess. U.S. Government Printing Office. Washington. 1928 (Parts 1, 2, 3, 4, and Appendix.)



United States Congress. House. Committee on Rules. Boulder Dam. Hearings on H.Res.146 and H.R. 5773 70th Cong. 1st Sess. U.S. Government Printing Office, Washington, 1928.

United States Congress. House. Committee on Irrigation and Reclamation. Boulder Canyon Project. Report on H.R. 5773 70th Cong. 1st. Sess. U.S. Government Printing Office. Washington. 1928.

United States Congress. House. Committee on Irrigation and Reclamation. Boulder Canyon Project. Minority Views of Mr. Douglas on H.R. 5773. 70th Cong. 1st Sess. U.S. Government Printing Office, Washington. 1928.

United States Congress. House. Committee on Irrigation and Reclamation. Boulder Dam Project. Minority Views of Mr. Leatherwood on H.R. 5773. 70th Cong. 1st Sess. U.S. Government Printing Office. Washington. 1928.

United States Congress. Senate. Committee on Irrigation and Reclamation. Boulder Canyon Project. Report on S. 728. 70th Cong. 1st Sess. U. S. Government Printing Office. Washington. 1928.

United States Congress. Senate. Committee on Irrigation and Reclamation. Colorado River Basin. Extracts from hearings on S.728 and S.1274. 70th Cong. 1st Sess. U.S. Government Printing Office. Washington. 1928.

United States Department of the Interior. Bureau of Reclamation. Development of the Lower Colorado River. Report of special advisers to Secretary of the Interior. U.S. Government Printing Office. Washington. 1928.

United States Department of Agriculture. Bureau of Soils. Soil Survey of the Brawley Area, California. U. S. Government Printing Office, Washington. 1923.

United States Department of Agriculture. Bureau of Soils. Soil Survey of the El Centro Area, California. U.S. Government Printing Office. Washington. 1922.

United States Geological Survey. Colorado River and its Utilization. Eugene Larue. U.S. Government Printing Office. Washington, 1916. (Water Supply Paper No.395)

United States Geological Survey. Water power and flood control of the Colorado River below Green River, Utah. Eugene Larue. U.S. Government Printing Office. Washington. 1925. (Water Supply Paper, No.556.)

BOOKS

Cory, H. T. Imperial Valley and the Salton Sink,

John J. Newbegin. San Francisco. 1915.

Dellenbaugh, F.S. A Canyon Voyage. G.P. Putnam and Sons.

New York and London. 1908.

Faris, John T. The Romance of the Rivers. Harper and Sons.

New York and London. 1927.

Freeman, Lewis R. The Colorado River, Yesterday and Today,

and Tomorrow. Dodd, Mead and Company. New York, 1923.

Freeman, Lewis R. Down the Grand Canyon. Dodd, Mead and

Company. New York. 1924.

Kennan, Geo. The Salton Sea. The MacMillan Company. New

York. 1917.

MAGAZINES AND PERIODICALS

- Arizona Position, The  
The Community Builder Hunt, Gov. Geo. P.  
March 1928.
- Arizona's Viewpoint on the Colorado River  
Journal of Electricity Hunt, G.P.  
Jan. 1, 1924.
- Battle With the Colorado  
American Review of Reviews Hampton, E. L.  
Nov. 1922.
- Boulder Canyon Dam Opposed and Defended  
Engineering News-Record Apr. 10, 1924
- Boulder Canyon Project  
Annals of the American Academy Johnson, Hiram W.  
Jan. 1928
- Boulder Canyon Project  
The Community Builder. Johnson, Hiram W.  
March 1928
- Building of Boulder Canyon Project Recommended  
New Reclamation Era Feb. 1926.
- California Position  
The Community Builder Young, Gov. C. C.  
March 1928
- Colorado River, The  
Century Austin, M.  
Aug. 1924
- Colorado River - A brief summary of data  
Engineering News-Record Jan. 8, 1925

## Colorado River Bill - A feasible measure

New Reclamation Era.

Mar. 1926.

## Colorado River Compact

Reclamation Record

Dec. 1922

## Colorado River Development

Hoover, Herbert C.

Industrial Management

May 1922

## Colorado River Dispute

Electrical World

Oct. 3, 1925

## Colorado River - Its control and development

Engineering News-Record.

May 4, 1922

## Colorado River - Los Angeles Aqueduct

Van Norman and Bagley

Engineering News-Record

May 31, 1928

## Colorado River Problem

Hoover, Herbert C.

The Community Builder

March 1928.

## Colorado River Problem

California Cultivator

Jan. 30, 1926.

## Colorado River Surveys

Davis, A. P.

The Community Builder

March 1928.

## Company Point of View Regarding Boulder Dam Koerner, C. W.

Annals of the American Academy

Jan. 1928

## Conditions in the Colorado Delta

Allison, J. G.

Engineering News-Record

Mar. 17, 1927.

- Conquering an American Nile Hoover, H. C.  
Nations Business Aug. 1922
- Conservation of the Waters of the Colorado River from the  
 Standpoint of the Reclamation Service. Weymouth, F.C.  
Science. July 21, 1922
- Converting the Colorado River into an Asset Johnson, Hiram  
Current History Feb. 1929
- Curbing the Colorado Skerrett, R. G.  
Scientific American April 1922
- Definite Federal Policy on Colorado River Urged  
New Reclamation Era April 1924
- Discord over the Boulder Dam  
Literary Digest Jan. 5, 1929
- Engineering and Economic Features of Boulder Dam. Scattergood, E.  
Annals of the American Academy Jan. 1928
- Federal Control of Boulder Dam Power and Water Favored  
Journal of Electricity Feb. 1, 1925.
- Federal Land Reclamation: A National Problem A series of  
 articles published weekly.  
Engineering News-Record Oct. 15, & Dec. 20, 1923.
- Federal Power Board on Boulder Dam  
Electrical World Mar. 29, 1924.







- Problems of the Colorado River  
Annals of the American Academy. Davis, A.P.  
 Jan. 1928.
- Salton Sea, The  
World To-day Blackmar, Frank W.  
 July 1906
- Salient Geographic Features of the Colorado River and Basin  
 James, H.P.  
Annals of the American Academy Jan. 1928
- Seven-State Irrigation Treaty  
Current History Hampton, E.L.  
 March 1923
- Shall More Land Be Reclaimed?  
Engineering News-Record Newell, F. H.  
 May 3, 1928
- Shall We Dam the Colorado?  
Review of Reviews Newell, F. H.  
 Nov. 1927.
- Should the Boulder Dam Bill be Passed?  
Congressional Digest. Douglas, L. W.  
 June-July, 1928
- Should the Boulder Dam Bill be Passed?  
Congressional Digest Swing, Philip  
 June-July 1928
- Silt and Channel Conditions in the Colorado River Delta  
 Rothery, S. L.  
Engineering News-Record Dec. 31, 1925
- States Rights and the Colorado Compact  
New Republic Landis, J.M.  
 Apr. 19, 1925
- Surveying the Grand Canyon of the Colorado  
National Geographic. Freeman, L.R.  
 May 1924

- Transmountain Diversion of Water in Colorado      Follansbee, R.  
Engineering News-Record      Jan.18,1923
- Utah's Position on the Colorado      Dern, Gov.Geo. H  
The Community Builder.      Mar.1928
- Utilization of the Colorado River      Mead, Elwood  
New Reclamation Era.      March 1926
- Water from the Colorado      Mulholland, W.  
The Community Builder      March 1928
- Western Irrigation and Its Future        
Engineering News-Record      Aug.5,1926
- What the Boulder Dam Project Means to California and the  
Nation.      Seavey, Clyde  
Annals of the American Academy      Jan. 1928
- Wonderful New Inland Sea      Larkin, E.L.  
Cosmopolitan Magazine      Oct. 1906

## NEWSPAPERS

San Francisco Chronicle

Dec. 4, 1928

Stockton Evening Record

Feb. 27, 1929

March 8, 1929

March 13, 1929

## APPENDIX

### Text of the Compact

Inasmuch as all discussion of the Colorado river problem at this time revolves around the document agreed upon at Santa Fe in 1922, an intimate understanding of its provisions is necessary to the formulation of conclusions. The text of the compact follows:

#### Article I

The major purposes of this contract are to provide for the equitable division and apportionment of the use of the waters of the Colorado river system; to establish the relative importance of different beneficial uses of water; to provide interstate comity; to remove causes of present and future controversies, and to secure the expeditious agricultural and industrial development of the Colorado river basin, the storage of its waters and the protection of life and property from floods. To these ends the Colorado river basin is divided into two basins, and an apportionment of the use of part of the water of the Colorado River system is made to each of them with the provision that further equitable apportionment may be made.

#### Article II

As used in this compact:

(a) The term "Colorado river system" means that portion of the Colorado river and its tributaries within the United States of America.

(b) The term "Colorado river basin" means all the drainage area of the Colorado river system and all other territory

within the United States of America to which the waters of the Colorado River system shall be beneficially applied.

(c) The term "states of the upper division" means the states of Colorado, New Mexico, Utah and Wyoming.

(d) The term "states of the lower division" means the states of Arizona, California and Nevada.

(e) The term "Lee Ferry" means a point in the main stream of the Colorado river one mile below the mouth of the Paria river.

(f) The term "upper Basin" means those parts of the states of Arizona, Colorado, New Mexico, Utah and Wyoming within and from which waters naturally drain into the Colorado river system above Lee Ferry, and also all parts of said states located without the drainage area of the Colorado river system which are now or shall hereafter be beneficially served by waters diverted from the system above Lee Ferry.

(g) The term "lower basin" means those parts of the states of Arizona, California, Nevada, New Mexico and Utah within and from which waters naturally drain into the Colorado river system below Lee Ferry, and also all parts of said states located without the drainage area of the Colorado river system which are now or shall hereafter be beneficially served by waters diverted from the system below Lee Ferry.

(H) The term "domestic use" shall include the use of water for household, stock, municipal, mining, milling, industrial and other like purposes, but shall exclude the generation of electrical power.

### Article III

(a) There is hereby apportioned from the Colorado river

system in perpetuity to the upper basin and to the lower basin, respectively, the exclusive beneficial consumptive use of 7,500,000 acre-feet of water per annum, which shall include all water necessary for the supply of any rights which may now exist.

(b) In addition to the apportionment in paragraph (a) the lower basin is hereby given the right to increase its beneficial consumptive use of such waters by one million acre-feet per annum.

(c) If, as a matter of international comity, the United States of America shall hereafter recognize in the United States of Mexico any right to the use of any waters of the Colorado river system, such waters shall be supplied first from the waters which are surplus over and above the aggregate of the quantities specified in paragraphs (a) and (b): and if such surplus shall prove insufficient for this purpose, then the burden of such deficiency shall be equally borne by the upper basin and the lower basin, and whenever necessary the states of the upper division shall deliver at Lee Ferry water to supply one-half of the deficiency so recognized in addition to that provided in paragraph (d).

(d) The states of the upper basin will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years reckoned in continuing progress series beginning with the first day of October next succeeding the ratification of this compact.

(e) The states of the upper division shall not withhold water, and the states of the lower division shall not require the delivery of water, which cannot reasonably be applied to domestic and agricultural use.

(f) Further equitable apportionment of the beneficial uses of the waters of the Colorado river system unapportioned by paragraphs (a), (b) and (c) may be made in the manner provided in paragraph (g) at any time after October 1, 1963, if and when either basin shall have reached its total beneficial consumptive use as set out in paragraphs (a) and (b).

(g) In the event of a desire for further apportionment as provided in paragraph (f) any two signatory states acting through their governors, may give joint notice of such desire to the governors of the other signatory states and to the president of the United States of America, and it shall be the duty of the governors of the signatory states and of the president of the United States of America forthwith to appoint representatives, whose duty it shall be to divide and apportion equitably between the upper basin and the lower basin the beneficial use of the unappropriated water of the Colorado river system as mentioned in paragraph (f), subject to the legislative ratification of the signatory states and the congress of the United States of America.

#### Article IV

(a) Inasmuch as the Colorado river has ceased to be navigable for commerce and the reservation of its waters for navigation would seriously limit the development of its basin, the uses of its waters for purposes of navigation shall be

subservient to the uses of such waters for domestic, agricultural and power purposes. If the congress shall not consent to this paragraph, the other provisions of this compact shall nevertheless remain binding.

(b) Subject to the provisions of this compact, water of the Colorado River system may be impounded and used for the generation of electrical power, but such impounding and use shall be subservient to the use and consumption of such water for agricultural and domestic purposes and shall not interfere with or prevent use for such dominant purposes.

(c) The provisions of this article shall not apply to or interfere with the regulation and control by any state within its boundaries of the appropriation, use and distribution of water.

#### Article V

The chief official of each signatory state charged with the administration of water rights, together with the director of the United States reclamation service and the director of the United States geological survey, shall cooperate, ex officio:

(a) to promote the systematic determination and coordination of the facts as to flow, appropriation, consumption and use of water in the Colorado river basin, and the interchange of available information in such matters.

(b) To secure the ascertainment and publication of the annual flow of the Colorado river at Lee Ferry.

(c) To perform such other duties as may be assigned by mutual consent of the signatories from time to time.



## Article VI

Should any claim or controversy arise between any two or more of the signatory states: (a) with respect to the waters of the Colorado river system not covered by the terms of this compact; (b) over the meaning or performance of any of the terms of this compact; (c) as to the allocation of the burdens incident to the performance of any article of this compact or the delivery of waters as herein provided; (d) as to the construction or operation of works within the Colorado river basin to be situated in two or more states, or to be constructed in one state for the benefit of another state, or (e) as to the diversion of water in one state for the benefit of another state; the governors of the states affected, upon the request of one of them, shall forthwith appoint commissioners with power to consider and adjust such claim or controversy, subject to ratification by the legislatures of the states so affected.

Nothing herein contained shall prevent the adjustment of any such claim or controversy by any present method or by direct future legislative actions of the interested states.

## Article VII

Nothing in this compact shall be construed as affecting the obligations of the United States of America to indian tribes.

## Article VIII

Present perfected rights to the beneficial use of waters of the Colorado river system are unimpaired by this compact.

Whenever storage capacity of 5,000,000 acre-feet shall have been provided on the main Colorado river within or for the benefit of the lower basin, then claims of such rights, if any, by appropriators or users of water in the lower basin against appropriators or users of water in the upper basin shall attach to and be satisfied from water that may be stored not in conflict with Article 3.

All other rights to beneficial use of waters of the Colorado river system shall be satisfied solely from the water apportioned to that basin in which they are situate.

#### Article IX

Nothing in this compact shall be construed to limit or prevent any state from instituting or maintaining any action or proceeding, legal or equitable, for the protection of any right under this compact or the enforcement of any of its provisions.

#### Article X

This compact may be terminated at any time by the unanimous agreement of the signatory states. In the event of such termination all rights established under it shall continue unimpaired.

#### Article XI

This compact shall become binding and obligatory when it shall have been approved by the legislatures of each of the signatory states and by the congress of the United States.

## [PUBLIC—No. 642—70TH CONGRESS]

[H. R. 5773.]

An Act To provide for the construction of works for the protection and development of the Colorado River Basin, for the approval of the Colorado River compact, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That for the purpose of controlling the floods, improving navigation and regulating the flow of the Colorado River, providing for storage and for the delivery of the stored waters thereof for reclamation of public lands and other beneficial uses exclusively within the United States, and for the generation of electrical energy as a means of making the project herein authorized a self-supporting and financially solvent undertaking, the Secretary of the Interior, subject to the terms of the Colorado River compact hereinafter mentioned, is hereby authorized to construct, operate, and maintain a dam and incidental works in the main stream of the Colorado River at Black Canyon or Boulder Canyon adequate to create a storage reservoir of a capacity of not less than twenty million acre-feet of water and a main canal and appurtenant structures located entirely within the United States connecting the Laguna Dam, or other suitable diversion dam, which the Secretary of the Interior is hereby authorized to construct if deemed necessary or advisable by him upon engineering or economic considerations, with the Imperial and Coachella Valleys in California, the expenditures for said main canal and appurtenant structures to be reimbursable, as provided in the reclamation law, and shall not be paid out of revenues derived from the sale or disposal of water power or electric energy at the dam authorized to be constructed at said Black Canyon or Boulder Canyon, or for water for potable purposes outside of the Imperial and Coachella Valleys: *Provided, however,* That no charge shall be made for water or for the use, storage, or delivery of water for irrigation or water for potable purposes in the Imperial or Coachella Valleys; also to construct and equip, operate, and maintain at or near said dam, or cause to be constructed, a complete plant and incidental structures suitable for the fullest economic development of electrical energy from the water discharged from said reservoir; and to acquire by proceedings in eminent domain, or otherwise, all lands, rights of way, and other property necessary for said purposes.

SEC. 2. (a) There is hereby established a special fund, to be known as the "Colorado River Dam fund" (hereinafter referred to as the "fund"), and to be available, as hereafter provided, only for carrying out the provisions of this Act. All revenues received in carrying out the provisions of this Act shall be paid into and expenditures shall be made out of the fund; under the direction of the Secretary of the Interior.

(b) The Secretary of the Treasury is authorized to advance to the fund, from time to time and within the appropriations therefor,

such amounts as the Secretary of the Interior deems necessary for carrying out the provisions of this Act, except that the aggregate amount of such advances shall not exceed the sum of \$165,000,000. Of this amount the sum of \$25,000,000 shall be allocated to flood control and shall be repaid to the United States out of 62½ per centum of revenues, if any, in excess of the amount necessary to meet periodical payments during the period of amortization, as provided in section 4 of this Act. If said sum of \$25,000,000 is not repaid in full during the period of amortization, then 62½ per centum of all net revenues shall be applied to payment of the remainder. Interest at the rate of 4 per centum per annum accruing during the year upon the amounts so advanced and remaining unpaid shall be paid annually out of the fund, except as herein otherwise provided.

(c) Moneys in the fund advanced under subdivision (b) shall be available only for expenditures for construction and the payment of interest, during construction, upon the amounts so advanced. No expenditures out of the fund shall be made for operation and maintenance except from appropriations therefor.

(d) The Secretary of the Treasury shall charge the fund as of June 30 in each year with such amount as may be necessary for the payment of interest on advances made under subdivision (b) at the rate of 4 per centum per annum accrued during the year upon the amounts so advanced and remaining unpaid, except that if the fund is insufficient to meet the payment of interest the Secretary of the Treasury may, in his discretion, defer any part of such payment, and the amount so deferred shall bear interest at the rate of 4 per centum per annum until paid.

(e) The Secretary of the Interior shall certify to the Secretary of the Treasury, at the close of each fiscal year, the amount of money in the fund in excess of the amount necessary for construction, operation, and maintenance, and payment of interest. Upon receipt of each such certificate the Secretary of the Treasury is authorized and directed to charge the fund with the amount so certified as repayment of the advances made under subdivision (b), which amount shall be covered into the Treasury to the credit of miscellaneous receipts.

Sec. 3. There is hereby authorized to be appropriated from time to time, out of any money in the Treasury not otherwise appropriated, such sums of money as may be necessary to carry out the purposes of this Act, not exceeding in the aggregate \$165,000,000.

Sec. 4 (a). This Act shall not take effect and no authority shall be exercised hereunder and no work shall be begun and no moneys expended on or in connection with the works or structures provided for in this Act, and no water rights shall be claimed or initiated hereunder, and no steps shall be taken by the United States or by others to initiate or perfect any claims to the use of water pertinent to such works or structures unless and until (1) the States of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming shall have ratified the Colorado River compact, mentioned in section 13 hereof, and the President by public proclamation shall have so declared, or (2) if said States fail to ratify the said compact within six months from the date of the passage of this Act then, until six of said States, including the State of California, shall ratify said

compact and shall consent to waive the provisions of the first paragraph of Article XI of said compact, which makes the same binding and obligatory only when approved by each of the seven States signatory thereto, and shall have approved said compact without conditions, save that of such six-State approval, and the President by public proclamation shall have so declared, and, further, until the State of California, by act of its legislature, shall agree irrevocably and unconditionally with the United States and for the benefit of the States of Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming, as an express covenant and in consideration of the passage of this Act, that the aggregate annual consumptive use (diversions less returns to the river) of water of and from the Colorado River for use in the State of California, including all uses under contracts made under the provisions of this Act and all water necessary for the supply of any rights which may now exist, shall not exceed four million four hundred thousand acre-feet of the waters apportioned to the lower basin States by paragraph (a) of Article III of the Colorado River compact, plus not more than one-half of any excess or surplus waters unapportioned by said compact, such uses always to be subject to the terms of said compact.

The States of Arizona, California, and Nevada are authorized to enter into an agreement which shall provide (1) that of the 7,500,000 acre-feet annually apportioned to the lower basin by paragraph (a) of Article III of the Colorado River compact, there shall be apportioned to the State of Nevada 300,000 acre-feet and to the State of Arizona 2,800,000 acre-feet for exclusive beneficial consumptive use in perpetuity, and (2) that the State of Arizona may annually use one-half of the excess or surplus waters unapportioned by the Colorado River compact, and (3) that the State of Arizona shall have the exclusive beneficial consumptive use of the Gila River and its tributaries within the boundaries of said State, and (4) that the waters of the Gila River and its tributaries, except return flow after the same enters the Colorado River, shall never be subject to any diminution whatever by any allowance of water which may be made by treaty or otherwise to the United States of Mexico but if, as provided in paragraph (c) of Article III of the Colorado River compact, it shall become necessary to supply water to the United States of Mexico from waters over and above the quantities which are surplus as defined by said compact, then the State of California shall and will mutually agree with the State of Arizona to supply, out of the main stream of the Colorado River, one-half of any deficiency which must be supplied to Mexico by the lower basin, and (5) that the State of California shall and will further mutually agree with the States of Arizona and Nevada that none of said three States shall withhold water and none shall require the delivery of water, which can not reasonably be applied to domestic and agricultural uses, and (6) that all of the provisions of said tri-State agreement shall be subject in all particulars to the provisions of the Colorado River compact, and (7) said agreement to take effect upon the ratification of the Colorado River compact by Arizona, California, and Nevada.

(b) Before any money is appropriated for the construction of said dam or power plant, or any construction work done or contracted

for, the Secretary of the Interior shall make provision for revenues by contract, in accordance with the provisions of this Act, adequate in his judgment to insure payment of all expenses of operation and maintenance of said works incurred by the United States and the repayment, within fifty years from the date of the completion of said works, of all amounts advanced to the fund under subdivision (b) of section 2 for such works, together with interest thereon made reimbursable under this Act.

Before any money is appropriated for the construction of said main canal and appurtenant structures to connect the Laguna Dam with the Imperial and Coachella Valleys in California, or any construction work is done upon said canal or contracted for, the Secretary of the Interior shall make provision for revenues, by contract or otherwise, adequate in his judgment to insure payment of all expenses of construction, operation, and maintenance of said main canal and appurtenant structures in the manner provided in the reclamation law.

If during the period of amortization the Secretary of the Interior shall receive revenues in excess of the amount necessary to meet the periodical payments to the United States as provided in the contract, or contracts, executed under this Act, then, immediately after the settlement of such periodical payments, he shall pay to the State of Arizona 18¾ per centum of such excess revenues and to the State of Nevada 18¾ per centum of such excess revenues.

Sec. 5. That the Secretary of the Interior is hereby authorized, under such general regulations as he may prescribe, to contract for the storage of water in said reservoir and for the delivery thereof at such points on the river and on said canal as may be agreed upon, for irrigation and domestic uses, and generation of electrical energy and delivery at the switchboard to States, municipal corporations, political subdivisions, and private corporations of electrical energy generated at said dam, upon charges that will provide revenue which, in addition to other revenue accruing under the reclamation law and under this Act, will in his judgment cover all expenses of operation and maintenance incurred by the United States on account of works constructed under this Act and the payments to the United States under subdivision (b) of section 4. Contracts respecting water for irrigation and domestic uses shall be for permanent service and shall conform to paragraph (a) of section 4 of this Act. No person shall have or be entitled to have the use for any purpose of the water stored as aforesaid except by contract made as herein stated.

After the repayments to the United States of all money advanced with interest, charges shall be on such basis and the revenues derived therefrom shall be kept in a separate fund to be expended within the Colorado River Basin as may hereafter be prescribed by the Congress.

General and uniform regulations shall be prescribed by the said Secretary for the awarding of contracts for the sale and delivery of electrical energy, and for renewals under subdivision (b) of this section, and in making such contracts the following shall govern:

(a) No contract for electrical energy or for generation of electrical energy shall be of longer duration than fifty years from the date at which such energy is ready for delivery.

Contracts made pursuant to subdivision (a) of this section shall be made with a view to obtaining reasonable returns and shall contain provisions whereby at the end of fifteen years from the date of their execution and every ten years thereafter, there shall be readjustment of the contract, upon the demand of either party thereto, either upward or downward as to price, as the Secretary of the Interior may find to be justified by competitive conditions at distributing points or competitive centers, and with provisions under which disputes or disagreements as to interpretation or performance of such contract shall be determined either by arbitration or court proceedings, the Secretary of the Interior being authorized to act for the United States in such readjustments or proceedings.

(b) The holder of any contract for electrical energy not in default thereunder shall be entitled to a renewal thereof upon such terms and conditions as may be authorized or required under the then existing laws and regulations, unless the property of such holder dependent for its usefulness on a continuation of the contract be purchased or acquired and such holder be compensated for damages to its property, used and useful in the transmission and distribution of such electrical energy and not taken, resulting from the termination of the supply.

(c) Contracts for the use of water and necessary privileges for the generation and distribution of hydroelectric energy or for the sale and delivery of electrical energy shall be made with responsible applicants therefor who will pay the price fixed by the said Secretary with a view to meeting the revenue requirements herein provided for. In case of conflicting applications, if any, such conflicts shall be resolved by the said Secretary, after hearing, with due regard to the public interest, and in conformity with the policy expressed in the Federal Water Power Act as to conflicting applications for permits and licenses, except that preference to applicants for the use of water and appurtenant works and privileges necessary for the generation and distribution of hydroelectric energy, or for delivery at the switchboard of a hydroelectric plant, shall be given, first, to a State for the generation or purchase of electric energy for use in the State, and the States of Arizona, California, and Nevada shall be given equal opportunity as such applicants.

The rights covered by such preference shall be contracted for by such State within six months after notice by the Secretary of the Interior and to be paid for on the same terms and conditions as may be provided in other similar contracts made by said Secretary: *Provided, however,* That no application of a State or a political subdivision for an allocation of water for power purposes or of electrical energy shall be denied or another application in conflict therewith be granted on the ground that the bond issue of such State or political subdivision, necessary to enable the applicant to utilize such water and appurtenant works and privileges necessary for the generation and distribution of hydroelectric energy or the electrical energy applied for, has not been authorized or marketed, until after a reasonable time, to be determined by the said Secretary, has been given to such applicant to have such bond issue authorized and marketed.

(d) Any agency receiving a contract for electrical energy equivalent to one hundred thousand firm horsepower, or more, may, when deemed feasible by the said Secretary, from engineering and eco-

conomic considerations and under general regulations prescribed by him, be required to permit any other agency having contracts hereunder for less than the equivalent of twenty-five thousand firm horsepower, upon application to the Secretary of the Interior made within sixty days from the execution of the contract of the agency the use of whose transmission line is applied for, to participate in the benefits and use of any main transmission line constructed or to be constructed by the former for carrying such energy (not exceeding, however, one-fourth the capacity of such line), upon payment by such other agencies of a reasonable share of the cost of construction, operation, and maintenance thereof.

The use is hereby authorized of such public and reserved lands of the United States as may be necessary or convenient for the construction, operation, and maintenance of main transmission lines to transmit said electrical energy.

SEC. 6. That the dam and reservoir provided for by section 1 hereof shall be used: First, for river regulation, improvement of navigation, and flood control; second, for irrigation and domestic uses and satisfaction of present perfected rights in pursuance of Article VIII of said Colorado River compact; and third, for power. The title to said dam, reservoir, plant, and incidental works shall forever remain in the United States, and the United States shall, until otherwise provided by Congress, control, manage, and operate the same, except as herein otherwise provided: *Provided, however*, That the Secretary of the Interior may, in his discretion, enter into contracts of lease of a unit or units of any Government-built plant, with right to generate electrical energy, or, alternatively, to enter into contracts of lease for the use of water for the generation of electrical energy as herein provided, in either of which events the provisions of section 5 of this Act relating to revenue, term, renewals, determination of conflicting applications, and joint use of transmission lines under contracts for the sale of electrical energy, shall apply.

The Secretary of the Interior shall prescribe and enforce rules and regulations conforming with the requirements of the Federal Water Power Act, so far as applicable, respecting maintenance of works in condition of repair adequate for their efficient operation, maintenance of a system of accounting, control of rates and service in the absence of State regulation or interstate agreement, valuation for rate-making purposes, transfers of contracts, contracts extending beyond the lease period, expropriation of excessive profits, recapture and/or emergency use by the United States of property of lessees, and penalties for enforcing regulations made under this Act or penalizing failure to comply with such regulations or with the provisions of this Act. He shall also conform with other provisions of the Federal Water Power Act and of the rules and regulations of the Federal Power Commission, which have been devised or which may be hereafter devised, for the protection of the investor and consumer.

The Federal Power Commission is hereby directed not to issue or approve any permits or licenses under said Federal Water Power Act upon or affecting the Colorado River or any of its tributaries, except the Gila River, in the States of Colorado, Wyoming, Utah,

New Mexico, Nevada, Arizona, and California until this Act shall become effective as provided in section 4 herein.

SEC. 7. That the Secretary of the Interior may, in his discretion, when repayments to the United States of all money advanced, with interest, reimbursable hereunder, shall have been made, transfer the title to said canal and appurtenant structures, except the Laguna Dam and the main canal and appurtenant structures down to and including Syphon Drop, to the districts or other agencies of the United States having a beneficial interest therein in proportion to their respective capital investments under such form of organization as may be acceptable to him. The said districts or other agencies shall have the privilege at any time of utilizing by contract or otherwise such power possibilities as may exist upon said canal, in proportion to their respective contributions or obligations toward the capital cost of said canal and appurtenant structures from and including the diversion works to the point where each respective power plant may be located. The net proceeds from any power development on said canal shall be paid into the fund and credited to said districts or other agencies on their said contracts, in proportion to their rights to develop power, until the districts or other agencies using said canal shall have paid thereby and under any contract or otherwise an amount of money equivalent to the operation and maintenance expense and cost of construction thereof.

SEC. 8. (a) The United States, its permittees, licensees, and contractors, and all users and appropriators of water stored, diverted, carried, and/or distributed by the reservoir, canals, and other works herein authorized, shall observe and be subject to and controlled by said Colorado River compact in the construction, management, and operation of said reservoir, canals, and other works and the storage, diversion, delivery, and use of water for the generation of power, irrigation, and other purposes, anything in this Act to the contrary notwithstanding, and all permits, licenses, and contracts shall so provide.

(b) Also the United States, in constructing, managing, and operating the dam, reservoir, canals, and other works herein authorized, including the appropriation, delivery, and use of water for the generation of power, irrigation, or other uses, and all users of water thus delivered and all users and appropriators of waters stored by said reservoir and/or carried by said canal, including all permittees and licensees of the United States or any of its agencies, shall observe and be subject to and controlled, anything to the contrary herein notwithstanding, by the terms of such compact, if any, between the States of Arizona, California, and Nevada, or any two thereof, for the equitable division of the benefits, including power, arising from the use of water accruing to said States, subsidiary to and consistent with said Colorado River compact, which may be negotiated and approved by said States and to which Congress shall give its consent and approval on or before January 1, 1929; and the terms of any such compact concluded between said States and approved and consented to by Congress after said date: *Provided*, That in the latter case such compact shall be subject to all contracts, if any, made by the Secretary of the Interior under section 5 hereof prior to the date of such approval and consent by Congress.

SEC. 9. That all lands of the United States found by the Secretary of the Interior to be practicable of irrigation and reclamation by the irrigation works authorized herein shall be withdrawn from public entry. Thereafter, at the direction of the Secretary of the Interior, such lands shall be opened for entry, in tracts varying in size but not exceeding one hundred and sixty acres, as may be determined by the Secretary of the Interior, in accordance with the provisions of the reclamation law, and any such entryman shall pay an equitable share in accordance with the benefits received, as determined by the said Secretary, of the construction cost of said canal and appurtenant structures; said payments to be made in such installments and at such times as may be specified by the Secretary of the Interior, in accordance with the provisions of the said reclamation law, and shall constitute revenue from said project and be covered into the fund herein provided for: *Provided*, That all persons who have served in the United States Army, Navy, or Marine Corps during the war with Germany, the war with Spain, or in the suppression of the insurrection in the Philippines, and who have been honorably separated or discharged therefrom or placed in the Regular Army or Navy Reserve, shall have the exclusive preference right for a period of three months to enter said lands, subject, however, to the provisions of subsection (c) of section 4, Act of December 5, 1924 (Forty-third Statutes at Large, page 702); and also, so far as practicable, preference shall be given to said persons in all construction work authorized by this Act: *Provided further*, That in the event such an entry shall be relinquished at any time prior to actual residence upon the land by the entryman for not less than one year, lands so relinquished shall not be subject to entry for a period of sixty days after the filing and notation of the relinquishment in the local land office, and after the expiration of said sixty-day period such lands shall be open to entry, subject to the preference in this section provided.

SEC. 10. That nothing in this Act shall be construed as modifying in any manner the existing contract, dated October 23, 1918, between the United States and the Imperial Irrigation District, providing for a connection with Laguna Dam; but the Secretary of the Interior is authorized to enter into contract or contracts with the said district or other districts, persons, or agencies for the construction, in accordance with this Act, of said canal and appurtenant structures, and also for the operation and maintenance thereof, with the consent of the other users.

SEC. 11. That the Secretary of the Interior is hereby authorized to make such studies, surveys, investigations, and do such engineering as may be necessary to determine the lands in the State of Arizona that should be embraced within the boundaries of a reclamation project, heretofore commonly known and hereafter to be known as the Parker-Gila Valley reclamation project, and to recommend the most practicable and feasible method of irrigating lands within said project, or units thereof, and the cost of the same; and the appropriation of such sums of money as may be necessary for the aforesaid purposes from time to time is hereby authorized. The Secretary shall report to Congress as soon as practicable, and not later than December 10, 1931, his findings, conclusions, and recommendations regarding such project.

SEC. 12. "Political subdivision" or "political subdivisions" as used in this Act shall be understood to include any State, irrigation or other district, municipality, or other governmental organization.

"Reclamation law" as used in this Act shall be understood to mean that certain Act of the Congress of the United States approved June 17, 1902, entitled "An Act appropriating the receipts from the sale and disposal of public land in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," and the Acts amendatory thereof and supplemental thereto.

"Maintenance" as used herein shall be deemed to include in each instance provision for keeping the works in good operating condition.

"The Federal Water Power Act," as used in this Act, shall be understood to mean that certain Act of Congress of the United States approved June 10, 1920, entitled "An Act to create a Federal Power Commission; to provide for the improvement of navigation; the development of water power; the use of the public lands in relation thereto; and to repeal section 18 of the River and Harbor Appropriation Act, approved August 8, 1917, and for other purposes," and the Acts amendatory thereof and supplemental thereto.

"Domestic" whenever employed in this Act shall include water uses defined as "domestic" in said Colorado River compact.

SEC. 13. (a) The Colorado River compact signed at Santa Fe, New Mexico, November 24, 1922, pursuant to Act of Congress approved August 19, 1921, entitled "An Act to permit a compact or agreement between the States of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming respecting the disposition and apportionment of the waters of the Colorado River, and for other purposes," is hereby approved by the Congress of the United States, and the provisions of the first paragraph of article 11 of the said Colorado River compact, making said compact binding and obligatory when it shall have been approved by the legislature of each of the signatory States, are hereby waived, and this approval shall become effective when the State of California and at least five of the other States mentioned, shall have approved or may hereafter approve said compact as aforesaid and shall consent to such waiver, as herein provided.

(b) The rights of the United States in or to waters of the Colorado River and its tributaries howsoever claimed or acquired, as well as the rights of those claiming under the United States, shall be subject to and controlled by said Colorado River compact.

(c) Also all patents, grants, contracts, concessions, leases, permits, licenses, rights of way, or other privileges from the United States or under its authority, necessary or convenient for the use of waters of the Colorado River or its tributaries, or for the generation or transmission of electrical energy generated by means of the waters of said river or its tributaries, whether under this Act, the Federal Water Power Act, or otherwise, shall be upon the express condition and with the express covenant that the rights of the recipients or holders thereof to waters of the river or its tributaries, for the use of which the same are necessary, convenient, or incidental, and the use of the same shall likewise be subject to and controlled by said Colorado River compact.

(d) The conditions and covenants referred to herein shall be deemed to run with the land and the right, interest, or privilege therein and water right, and shall attach as a matter of law, whether set out or referred to in the instrument evidencing any such patent, grant, contract, concession, lease, permit, license, right of way, or other privilege from the United States or under its authority, or not, and shall be deemed to be for the benefit of and be available to the States of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming, and the users of water therein or thereunder, by way of suit, defense, or otherwise, in any litigation respecting the waters of the Colorado River or its tributaries.

SEC. 14. This Act shall be deemed a supplement to the reclamation law, which said reclamation law shall govern the construction, operation, and management of the works herein authorized, except as otherwise herein provided.

SEC. 15. The Secretary of the Interior is authorized and directed to make investigation and public reports of the feasibility of projects for irrigation, generation of electric power, and other purposes in the States of Arizona, Nevada, Colorado, New Mexico, Utah, and Wyoming for the purpose of making such information available to said States and to the Congress, and of formulating a comprehensive scheme of control and the improvement and utilization of the water of the Colorado River and its tributaries. The sum of \$250,000 is hereby authorized to be appropriated from said Colorado River Dam fund, created by section 2 of this Act, for such purposes.

SEC. 16. In furtherance of any comprehensive plan formulated hereafter for the control, improvement, and utilization of the resources of the Colorado River system and to the end that the project authorized by this Act may constitute and be administered as a unit in such control, improvement, and utilization, any commission or commissioner duly authorized under the laws of any ratifying State in that behalf shall have the right to act in an advisory capacity to and in cooperation with the Secretary of the Interior in the exercise of any authority under the provisions of sections 4, 5, and 14 of this Act, and shall have at all times access to records of all Federal agencies empowered to act under said sections, and shall be entitled to have copies of said records on request.

SEC. 17. Claims of the United States arising out of any contract authorized by this Act shall have priority over all others, secured or unsecured.

SEC. 18. Nothing herein shall be construed as interfering with such rights as the States now have either to the waters within their borders or to adopt such policies and enact such laws as they may deem necessary with respect to the appropriation, control, and use of waters within their borders, except as modified by the Colorado River compact or other interstate agreement.

SEC. 19. That the consent of Congress is hereby given to the States of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming to negotiate and enter into compacts or agreements, supplemental to and in conformity with the Colorado River compact and consistent with this Act for a comprehensive plan for the development of the Colorado River and providing for the storage, diversion, and use of the waters of said river. Any such compact

or agreement may provide for the construction of dams, headworks, and other diversion works or structures for flood control, reclamation, improvement of navigation, division of water, or other purposes and/or the construction of power houses or other structures for the purpose of the development of water power and the financing of the same; and for such purposes may authorize the creation of interstate commissions and/or the creation of corporations, authorities, or other instrumentalities.

(a) Such consent is given upon condition that a representative of the United States, to be appointed by the President, shall participate in the negotiations and shall make report to Congress of the proceedings and of any compact or agreement entered into.

(b) No such compact or agreement shall be binding or obligatory upon any of such States unless and until it has been approved by the legislature of each of such States and by the Congress of the United States.

SEC. 20. Nothing in this Act shall be construed as a denial or recognition of any rights, if any, in Mexico to the use of the waters of the Colorado River system.

SEC. 21. That the short title of this Act shall be "Boulder Canyon Project Act."

Approved, December 21, 1928.



B

METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA, AUTHORIZED BY VOTE OF THE PEOPLE NOVEMBER 6, 1928, AND EMBRACING THE FOLLOWING ELEVEN CITIES, BEVERLY HILLS, BURBANK, GLENDALE, PASADENA, SANTA MONICA, SAN MARINO, LOS ANGELES, ANAHEIM, SANTA ANA, SAN BERNARDINO AND COLTON, WITH ESSENTIAL DATA.

CITIES	BALLOT NOV. 6, 1928		POPULATION 1927 EST.	LATEST AVAILABLE VALUATION
	YES	NO		
<u>LOS ANGELES COUNTY</u>				
Beverly Hills	2,592	647	10,500	\$ 59,412,840
Burbank	2,265	950	25,000	23,393,795
Glendale	14,232	3,247	80,000	74,424,860
Pasadena	19,438	2,007	80,000	124,126,620
Santa Monica	6,087	1,183	45,000	63,923,940
San Marino	682	122	2,500	14,607,065
Los Angeles	182,694	54,756	1,375,000	1863,559,210
Total	227,988	62,912	1,618,000	2223,448,330
<u>ORANGE COUNTY</u>				
Anaheim	1,792	607	13,000	\$ 7,878,185
Santa Ana	6,211	1,277	35,000	20,336,065
	8,003	1,884	48,000	28,214,250
<u>SAN BERNARDINO CO.</u>				
San Bernardino	5,032	2,262	40,000	\$ 18,239,928
Colton	717	484	8,500	3,516,359
	5,749	2,746	48,500	21,801,787
<u>TOTAL</u>	241,740	67,542	1,714,500	2273,464,367

SEVERAL OTHER CITIES ARE LIKELY TO JOIN DISTRICT, INCLUDING THE FOLLOWING, ALHAMBRA, INGLEWOOD, LONG BEACH AND SOUTH PASADENA.

Alhambra			30,000	\$ 26,090,915
Inglewood			22,950	15,820,335
Long Beach			144,000	162,996,420
Total			196,950	\$204,907,670

# Imperial County, California

## 1928 Statistics

### Assessed Valuation

1900	1910	1928
0	\$12,148,180	\$54,248,738

### County Values

Real Estate and Improvements .....	1928	\$88,367,398
Desert Land Value, Estimated .....	1928	10,280,000
Mineral Resource Value .....	1928	725,820
		<b>\$99,373,218</b>

Imperial Irrigation District .....	1928	\$21,945,467
School Values .....	1928	5,005,700
Crop Values .....	1928	51,429,632
Live Stock Values .....	1928	11,101,767
		<b>\$89,482,566</b>

Bank Capitalization .....	1928	118,050,000
Bank Deposits .....	1928	10,271,923
Bank Clearings .....	1928	65,313,878
Postal Receipts .....	1928	153,035

Average Mean Temperature .....	1928	72 Degrees
Total Rainfall .....	1928	0.28 Inch
First Killing Frost.....Season 1927-1928		Dec. 22
Last Killing Frost.....Season 1927-1928		Jan. 16th
Average Relative Humidity.....	1928	0.29

Population 1900—0      Population 1928—60,000

Number of Farms .....	4,759
Operated by Tenants .....	2,947
Number of Property Owners .....	10,395
Operated by Owners .....	1,812
Irrigated Area .....	525,797 Acres

### Total Values

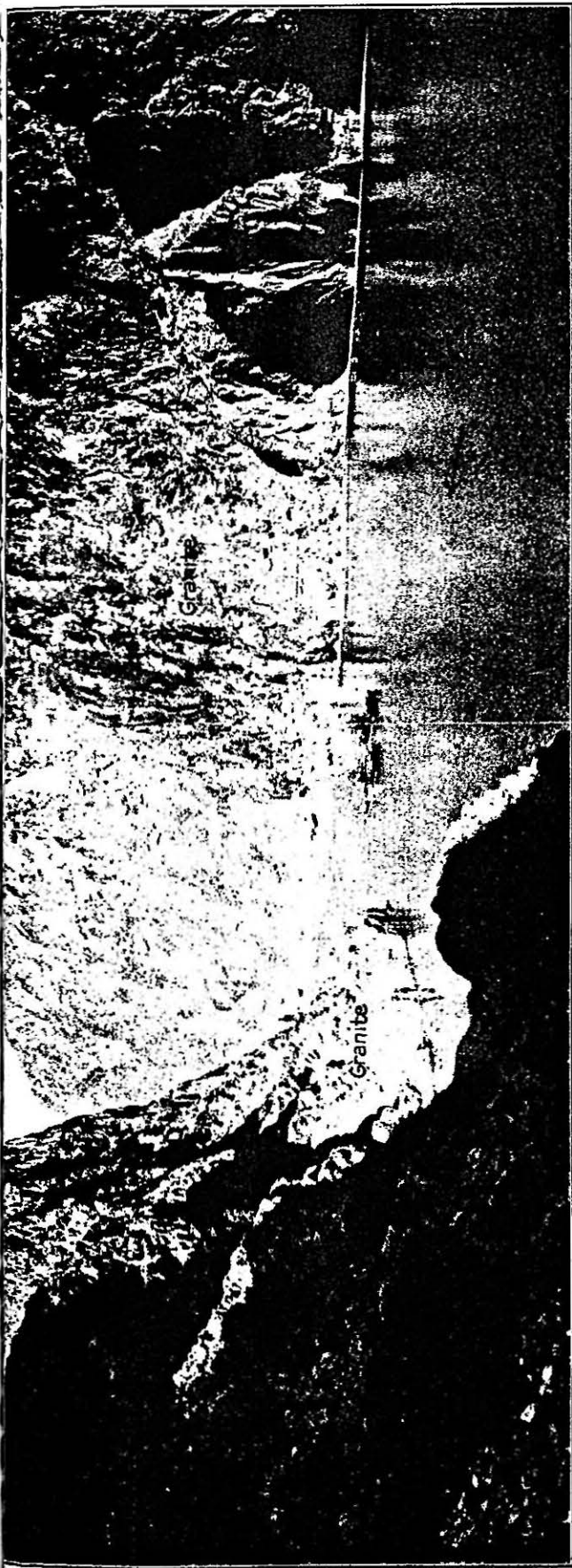
County Values .....	1928	\$ 99,373,218
School Values .....	1928	5,005,700
Irrigation District Valuation, Engineer's Estimate .....	1928	21,945,467
Crops and Live Stock Valuation.....	1928	62,581,399
Total County Value .....		<b>\$188,855,784</b>

### Crop and Livestock Values

Alfalfa .....	10,480 carloads	\$ 3,145,000
Barley .....	1,000 carloads	930,000
Milo Maize .....	580 carloads	504,600
Wheat .....	75 carloads	88,284
Rice .....	24 carloads	43,200
Cotton .....	148 carloads	684,500
Cotton by-products ..	1,066 carloads	1,541,950
Lettuce .....	12,286 carloads	10,252,689
Watermelons .....	3,820 carloads	1,301,856
Squash and Cucumbers .....	320 carloads	426,666
Carrots .....	789 carloads	688,008
Spinach .....	27 carloads	18,688
Tomatoes .....	551 carloads	652,174
Peas .....	354 carloads	669,813
Cantaloupes .....	20,035 carloads	19,460,999
Honey Dewes .....	1,500 carloads	1,750,500
Honey Balls .....	793 carloads	782,088
Miscellaneous Melons	510 carloads	672,045
Asparagus .....	138 carloads	722,196
Grapes .....	465 carloads	883,969
Strawberries .....	20 carloads	60,000
Dates .....	100,000 pounds	50,000
Grapefruit .....	135 carloads	152,887
Pecans .....	2,800 pounds	1,400
Honey .....	900,000 pounds	67,500
Butter Fat .....	6,000,000 pounds	2,863,000
Powdered Milk .....	64 carloads	256,000
Hides .....	12 carloads	108,000
Wool .....	3 carloads	40,500
Ice .....	319,515 tons	2,556,120
Cattle .....	55,000 head	5,885,000
Dairy Cattle .....	26,000 head	2,997,191
Horses .....	9,683 head	726,225
Mules .....	2,169 head	124,365
Sheep .....	92,504 head	839,936
Hogs .....	14,912 head	151,920
Poultry .....	9,138 dozen	91,380
Turkeys .....	652,500 pounds	195,750
Bees .....	15,000 stands	90,000

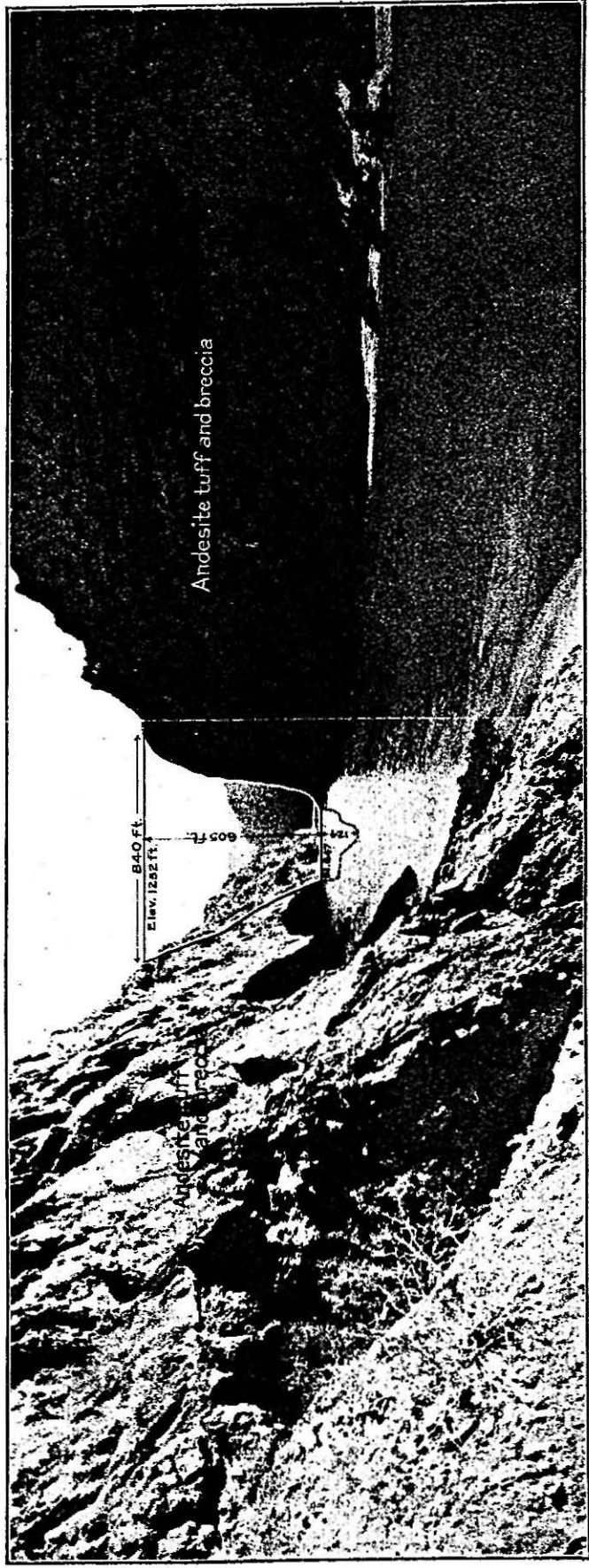
Total cars shipped, 1928 56,173      \$62,531,399

THESE statistics were compiled by the Imperial County Board of Trade under the supervision of the Board of Supervisors. Anyone wishing further information concerning Imperial Valley farm lands and lands affected by Boulder Dam project may write Imperial County Board of Trade, Court House, El Centro, or may obtain it at Imperial Valley desk located in Chamber of Commerce Building, Los Angeles, 12th and Hill Streets.



4. BOULDER CANYON DAM SITE, SHOWING BARGES USED IN DIAMOND-DRILL WORK

Geology by F. L. Ransome



5. UPPER BLACK CANYON DAM SITE

Geology by F. L. Ransome