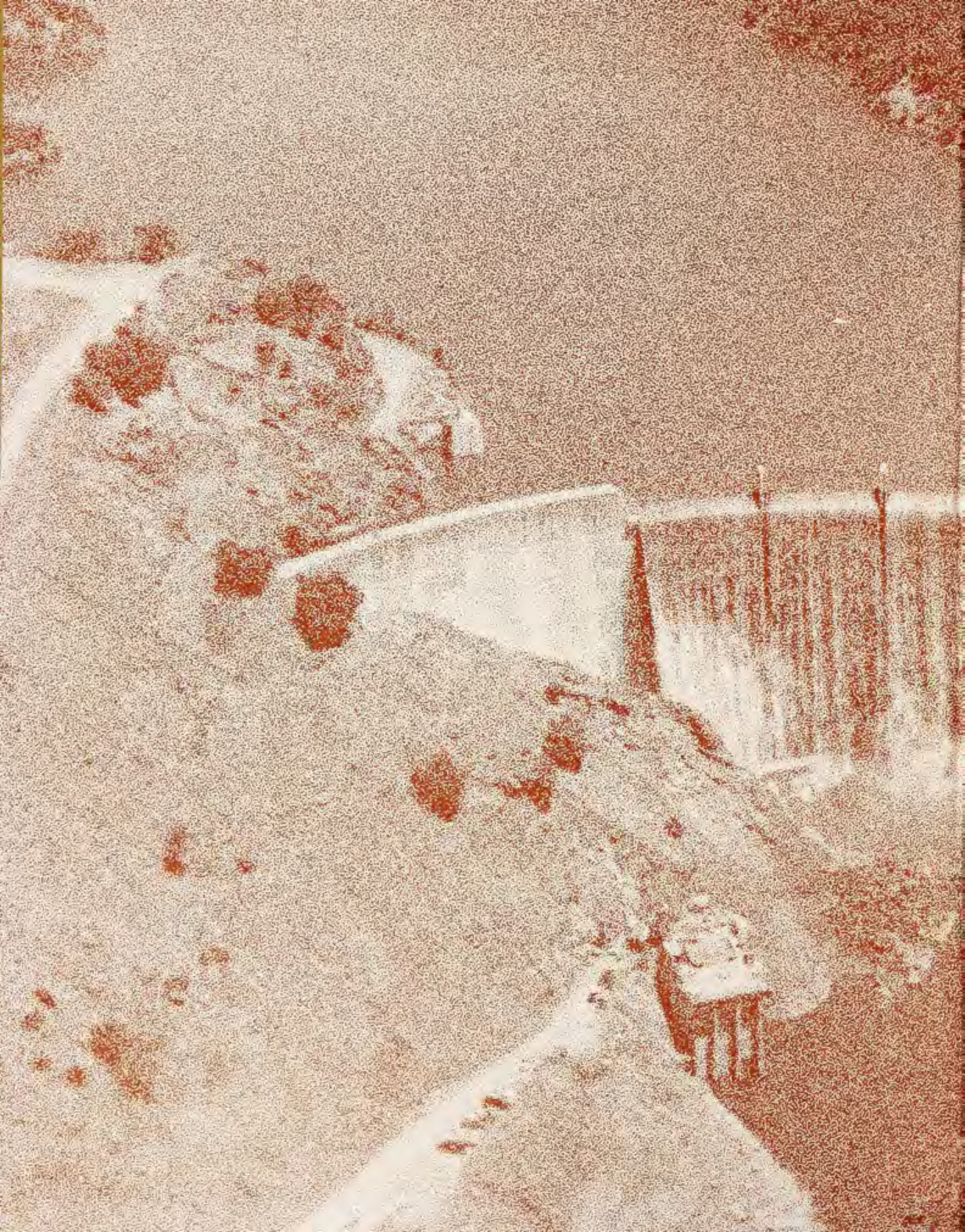
THE CALIFORNIA DEBRIS COMMISSION:

A HISTORY

U.S. Army Corps of Engineers
Sacramento District



The California Debris Commission

A history of the hydraulic mining industry in the western Sierra Nevada of California, and of the governmental agency charged with its regulation.

By
Joseph J. Hagwood, Jr
1981

About The Author

JOSEPH J. HAGWOOD, Jr., is a professional historian. In addition to this book, he has prepared histories of the Sacramento and San Francisco Districts, and the South Pacific Division, U.S. Army Corps of Engineers. Mr. Hagwood is presently researching the ecological history of San Francisco Bay. When not writing for the Corps of Engineers, he serves as the Director of Curriculum Services for the Plumas Unified School District, Quincy, California.

A 1963 graduate of California State University, Sacramento, he earned a Master's in history from that institution in 1970. His thesis, about the hydraulic mining industry in California, was entitled, "From North Bloomfield to North Fork: Attempts to Comply with the Sawyer Decision."

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Preface

The California Debris Commission (CDC) is a unique regulatory body that has functioned for almost a century in the richest and most highly populated state of the wealthiest and most powerful nation that has ever existed. During its long history the Commission has exerted a potent influence upon the growth and development of California by determining, to a significant degree, how the critical resources of the State would be developed.

These resources — water, navigation, gold and agriculture — and those involved in their utilization have often been the source of bitter ideological, political and economic conflict. This strife was the result of the peculiar circumstances of geography, history, migration, settlement, geology and governmental policies.

The latter, acting one upon the others, spawned the circumstances that led to the creation of the California Debris Commission.

Despite the largeness of the role played by the Commission over the years, few people of the State know of its existence, hence the general population can have little if any appreciation of the contribution made by the CDC. It is the purpose of this history to illuminate the conditions and events that brought the Commission into being, and then to trace the record of achievements made by this novel, but little-heralded, group of dedicated individuals.

So that we can gain an accurate picture of the Commission and its subsequent work, we must first possess some notion of its geological, geographical, historical and economic antecedents.

In our preoccupation with the often superficial and transient happenings in our daily lives, we take the landforms around us for granted. Moreover, our short-term successes in tinkering with the natural environment have given us the myopic, and possibly dangerous, view that we can control Nature. Yet for all our technological achievements, California remains firmly influenced by specific factors which gave rise, in part at least, to the conflicts that caused the California Debris Commission to be formed.

Millions of years ago the streams in what is now California flowed in a direction that was somehwat perpendicular to the modern rivers that course down the western slope of Sierra Nevada Mountains. Over time, gold became imbedded in these ancient stream channels. Modern streams cut through the old ones and released the gold contained therein, and deposited it along the banks of today's rivers. It was this placer gold that was panned by the 49ers.

Once this supply was exhausted, the prospectors found — rather by accident — immense quantities of gold trapped in the ancient channels. When the miners began to recover this treasure by tearing down the mountains with huge amounts of water under terrific pressure (hydraulic mining), they clogged the creeks and river channels with debris.

For a while at least, valley business interests carried on a brisk trade with the mining communities, while farmers and ranchers profited handsomely by selling foodstuff to the mountain folk. In addition, riverboat owners shared in the economic boom by bringing passengers and material to and from the new financial and cultural centers of Stockton, Sacramento and Marysville, located on the main stems of California's vast inland waterway system.

Little by little, however, the debris was creeping down the steep water courses of the mountains and coming to rest in the main river channels. Then in the 1860s torrential rains burst upon the land and washed significant amounts of the detritus out of the mountains and onto the valley floor. Cries of protest were heard from the agriculturists as their fields became covered with sand, gravel and mud. At the same time navigation interests and the businessmen they supplied protested loud and long because they could not get their steamboats up river as in times past.

Litigation was inevitable. Following years of hostility and legal maneuvering, the miners were, in 1884, enjoined from placing debris in streams that were tributary to navigable waterways. By sheer force of will and considerable political support from mining district congressmen, the miners were able to secure a measure of relief from the federal government. During the summer of 1893 the California Debris Commission was formed to regulate hydraulic mining in such a way that would allow its resumption. The Commission was also given the charge to formulate plans for the improvement of navigation and flood control.

The federal law that created the Debris Commission was for years known as the Caminetti Act, taking its name from the author of the legislation, Anthony Caminetti. After organization of the CDC, applications to mine by the hydraulic process literally poured into its San Francisco office. To receive a license, mine owners had to convince the Commission that storage facilities available to them were sufficient to keep the debris generated by their hydraulic mining from entering the Sierra streams. There were of course many parts to the law, but essentially the key to being granted a license to mine was the ability to keep the mud, rocks and sand out of the rivers.

In the long run the hydraulic mining aspects of the Caminetti Act proved to be of a secondary nature in the overall scheme of things. The truly significant contributions made by the Commission were, and remain, connected to river reclamation. Thus the focus of the Commission's work soon centered upon the Yuba, Feather and Sacramento Rivers where the debris problem was most serious. Specifically, the lower Yuba River, the Feather River below the mouth of the Yuba, and the Sacramento River below the mouth of the Feather (including the upper section of Suisun Bay) contained the worst stretches of sand-filled channels in the entire area — and most of this sand and related debris came from the Yuba River.

Some of the first river work accomplished by the Commission was the construction of debris barriers in the channel of the Yuba River. The idea was to keep as much of the debris as possible stored in the bed of the Yuba and out of the navigable channels of the Feather and Sacramento Rivers. The barrier work was followed by a variety of dredging, clearing and other projects designed to allow the rivers to flow freely from the foothills to San Francisco Bay. Though prosecuted vigorously, the initial work completed by the Commission simply wasn't enough to alleviate the terrible conditions of the rivers.

The basic problem, even without the burden placed upon the drainage system by hydraulic mining, was that during flood stage the Sacramento River channel was too small to contain the terrific flows trying to course their way through the main artery. Shortly after the turn of the century, the Debris Commission formulated a rather sophisticated plan to deal with the entire issue. The concepts were brought together, adopted by Congress in 1910,

and provided for the following:

a. enlargement of the Sacramento river channel below the mouth of Cache Slough.
b. making four cut-offs between the Feather River and the town of Colusa.
c. the construction of four by-pass weirs.

Over the years the original 1910 project was modified and expanded until it included all varieties of works designed to improve navigation and provide flood protection to the Sacramento Valley.

A pair of colorful and unique projects were completed just prior to American involvement in the Second World War. These were North Fork Dam on the American River and Upper Narrows Dam on the Yuba River. Spawned by a desperate notion that large retaining barriers would make feasible the resumption of hydraulic mining, victims of the Great Depression argued successfully for the construction of government-sponsored dams. The dream was to have the Commission put up the dams using federal monies. Once completed, the government would be reimbursed by taxes collected on every yard of material mined and/or stored behind these dams. The scheme, though honest and sincere, was doomed to failure. The dead giant that was the hydraulic mining industry was beyond revival. The Commission upheld its end of the bargain and raised the dams. The mining industry failed to pick up the pieces and keep the promises made. It was not a case of would not but, rather could not. Conditions had so radically changed by mid-century that nothing could prevail against the dominant forces holding sway at that period in our history.

From the time of its creation in 1893 up to the present day, the CDC has endeavored to carry out its mandate. Though it has proven impossible to discover a satisfactory method to allow resumption of mining by the hydraulic method, much has been done by the Commission relative to channel reclamation and flood control.

Over the years, the California Debris Commission's duties have, for the most part, been assumed by other branches of the Corps of engineers. While it maintains authority over hydraulic mining activities, responsibility for river reclamation and flood control has, for all intents and purposes, been absorbed as functions of the regular organization of the Sacramento District, U.S. Army Corps of Engineers. Even so, the Commission, as a special regulatory board of the Corps of Engineers, has enjoyed a proud and colorful history — one that is worthy of being preserved for future generations.

The author is especially grateful for the many kindnesses shown him by the staff of the Sacramento District.

Without the assistance of many of the Sacramento District's personnel, it would not have been possible to prepare this history. Special thanks are extended to Colonel Paul Kavanaugh, District Engineer; Mr. Carl Greenstein, Chief, Public Affairs Office; Mr. James Taylor, Assistant Public Affairs Officer; Mrs. Wanda Hunt, Librarian; Mr. George Rivera, Chief, Office of Administrative Services; and Mr. Arnold Lee, Photographer. In addition, a debt of gratitude is acknowledged for the assistance so willingly given by the staff of the Plumas County Library, Quincy, California. Finally, a word of thanks is expressed to Martha Taborski and Karen Gilliland who have served as editors and typists for this work.

Officers of the California Debris Commission

ORGANIZED JUNE 8, 1893

1893-1895 Commission appointed by the President of the United States on May 3, 1893, consisted of Colonel G.H. Mendell, president, and Lieutenant Colonel W.H.H. Benyaurd and Major W.H. Heuer, members. On September 6, 1893, Lieutenant Cassius E. Gillette relieved Major Heuer of his responsibilities as executive and disbursing officer in charge of records and office functions.

1896-1897 Colonel Charles R. Suter, President from March 3, 1896
Major E.L. B. Davis
Captain C.E. Gillette

1898 Colonel C.R. Suter, President
Major W.H. Heuer from November 18, 1897
Major Charles E.L.B. Davis to November 19, 1887
First Lieutenant Herbert Deakyne

1899-1900 Colonel C.R. Suter, President to October 15, 1898
Colonel S.M. Mansfield, President since October 15, 1898
Major W.H. Heuer
Lieutenant H. Deakyne, designated Secretary

1901 Colonel S.M. Mansfield, President to February 9, 1901
Colonel Jared A. Smith, President from February 9, 1901
Lieutenant Colonel W.H. Heuer
Captain H. Deakyne, Secretary

1902-1903 Colonel Jared A. Smith, President to September 22, 1901
Lieutenant Colonel D.P. Heap, President from September 22, 1901
Lieutenant Colonel W.H. Heuer
Captain H. Deakyne to August 23, 1901
First Lieutenant R.P. Johnston from August 23, 1901

1904 Colonel D.P. Heap, President to September 10, 1903
Colonel W.H. Heuer
Lieutenant Colonel Thomas Handbury from September 10, 1903
Captain William W. Harts, from September 19, 1903
Captain R.P. Johnston, to September 19, 1903

1905 Colonel W.H. Heuer, President
Colonel T.H. Handbury
Captain W.W. Harts

1906 Colonel W.H. Heuer, President
Major C.H. McKinstry
Captain W.W. Harts
On April 18-21, 1906, a large part of the city of San Francisco was destroyed by earthquake and fire. The office of the Commission was burned, all maps, records, and property being a total loss. A special appropriation of $5,000 was made by act of Congress, approved June 30, 1906, as follows:
"Expenses, California Debris Commission: For furniture, stationery, instruments, photographic appliances, and all labor and materials necessary to restore records and property of all sorts destroyed during the earthquake and consequent conflagration of April . . ." (Annual Report of 1907)

1907-1908 Lieutenant Colonel John Biddle, President
Major C.H. McKinstry
Captain Thomas H. Jackson

1909-1910 Lieutenant Colonel John Biddle, President
Captain T.H. Jackson
First Lieutenant Charles T. Leeds

1911 Colonel John Biddle, President
Captain T.H. Jackson to April 25, 1911
Major S.A. Cheney from April 25, 1911
Captain C.T. Leeds

1912 Colonel John Biddle, President to August 2, 1911
Lieutenant Colonel Thomas H. Rees, President from August 15, 1911
Lieutenant Colonel C.H. McKinstry from April 26, 1912
Major S.A. Cheney to April 26, 1912
Captain C.T. Leeds to April 26, 1912

1913 Lieutenant Colonel T.H. Rees
Lieutenant Colonel C.H. McKinstry
Major S.A. Cheney

1914 Lieutenant Colonel T.H. Rees, President
Lieutenant Colonel C.H. McKinstry to January 30, 1914
Major R.R. Raymond from January 30, 1914
Major S.A. Cheney

1915 Lieutenant Colonel T.H. Rees, President
Major R.R. Raymond
Major S.A. Cheney, Secretary to August 7, 1914
Major L.H. Rand, Secretary from August 7, 1914
NOTE: Annual Report states that the **Secretary** is responsible for the immediate supervision of the work of the Commission.

1916 Lieutenant Colonel T.H. Rees, President
Major R.R. Raymond to January 31, 1916
Major L.H. Rand, Secretary
Captain Richard Park from February 1, 1916

1917 Colonel T.H. Rees, President to February 1, 1917
Colonel Edward Burr from February 1, 1917
Major L.H. Rand, Secretary
Major R. Park

1918-1919 Colonel Edward Burr to July 3, 1917
Colonel W.H. Heuer, U.S. Army (Retired), from February 23 to June 30, 1918
Colonel Charles L. Potter from February 23 to June 30, 1918
Colonel L.H. Rand, Secretary
Lieutenant Colonel R. Park from July 1, 1917 to February 23, 1918

1920 Colonel W.H. Heuer (Retired), President to July 31, 1919
Colonel C.L. Potter, member to April 12, 1920, and President from August 1, 1919, to April 12, 1920
Colonel T.H. Rees, President from April 13, 1920
Colonel E.E. Winslow from August 14, 1919

Lieutenant Colonel L.H. Rand, Secretary to May 25, 1920
Lieutenant Colonel W. Kelley, Secretary to July 31, 1920.

1921 Colonel T.H. Rees, President
Colonel E.E. Winslow to September 16, 1920
Colonel H. Deakyne from September 16, 1920
Lieutenant W. Kelley, Secretary to August 26, 1920
Major U.S. Grant, 3d, to July 31, 1921

1922 Colonel T.H. Rees President
Colonel H. Deakyne
Major U.S. Grant, 3d, Secretary

1923-1924 Colonel Herbert Deakyne, President
Major U.S. Grant, 3d, Secretary
Major E.D. Ardery, appointed Secretary in 1924

1925 Colonel Herbert Deakyne, President to June 5, 1925
Lieutenant Colonel G.R. Lukesh from June 5, 1925
Major U.S. Grant, 3d, Secretary
Major E.D. Ardery to July 30, 1924
Major H.A. Finch to June 27, 1925
Major C.S. Ridley from June 27, 1925
Colonel J.W.N. Schulz from June 27, 1925

1926 Lieutenant Colonel G.R. Lukesh, President
Major C.S. Ridley, Secretary
Major J.W.N. Schulz

1927 Lieutenant Colonel G.R. Lukesh, President to November 2, 1926
Colonel Thomas H. Jackson replaced Lieutenant Col. Lukesh as President on that date
Major C.S. Ridley, Secretary
Major J.W.N. Schulz

1928 Colonel Thomas H. Jackson, President to June 19, 1928
Lieutenant Colonel J. Franklin Bell, President from June 19, 1928
Major C.S. Ridley, Secretary
Major E.H. Ropes

1929 Lieutenant Colonel J. Franklin Bell, President
Major E.H. Ropes, Secretary to July 31, 1928
Lieutenant Colonel T.H. Emerson, Secretary from July 31, 1928
Major E.H. Ropes, member
Until September 11, 1929, the Commission consisted of:
Lieutenant Colonel J. Franklin Bell, President
Lieutenant Colonel T.H. Emerson, Secretary
Major E.H. Ropes
From September 11, 1929 to December 4, 1929, the Commission consisted of:
Lieutenant Colonel J. Franklin Bell, President
Major J.R.D. Matheson, Secretary
Major E.H. Ropes
On December 4, 1929, Lieutenant Colonel T.M. Robins was appointed President

1930-1931 Lieutenant Colonel T.M. Robins, President
Major J.R.D. Matheson, Secretary
Major E.H. Ropes
On March 21, 1931, Lieutenant Colonel R.S. Thomas replaced Major E.H. Ropes

1932 (From August 4, 1931 to April 2, 1932)
Lieutenant Colonel T.M. Robins, President
Lieutenant Colonel H.A. Finch
Major J.R.D. Matheson, Secretary

1933-1934 Lieutenant Colonel T.M. Robins, President
Lieutenant Colonel H.A. Finch
Captain J.G. Drinkwater, Secretary
On February 7, 1934, Major E.S.J. Irvine replaced Lieutenant Colonel H.A. Finch

1935-1936 Colonel T.H. Jackson, President, since August 21, 1935
Major E.S.J. Irvine
Captain J.G. Drinkwater, Secretary
On September 21, 1935, Lieutenant Colonel L.B. Chambers replaced Captain Drinkwater as Secretary
On September 14, 1936, Colonel T.H. Jackson was replaced by Colonel John J. Kingman as President

1937-1940 Brigadier General John J. Kingman to March 3, 1938
Colonel Warren T. Hannum from March 3, 1938
Colonel L.B. Chambers, Secretary
Major E.S.J. Irvine to August 25, 1937
Major Frank M.S. Johnson from August 25, 1937
On January 26, 1940, Major Robert C. Hunter became Secretary
Major Henry C. Wolf, November 1, 1940, to March 21, 1941
Colonel J.R.D. Matheson from March 21, 1941

World War II

On December 1, 1942, the Mountain Division, the North Pacific Division and the South Pacific Division were abolished and replaced by the Pacific Division with headquarters in Salt Lake City. (General Order No. 40, Office of Chief of Engineers, dated October 26, 1942) General Warren T. Hannum became Division Engineer and, as such, exercised overall control of the California Debris Commission. A branch office of the Pacific Division was established at the pre-existing South Pacific Division headquarters, 351 California Street, San Francisco. Assistant Division Engineer Colonel E.M. George was given authority for mining and debris control operations. He also served as District engineer of the San Francisco District and, as such, was a member of the Debris Commission. During the war years, he was subsequently replaced by Colonel James D. Andrews, Jr. (1942-44), Colonel K.M. Moore (1944-45), and Lieutenant Colonel Harold E. George (1945-46).

On October 10, 1943, Colonel Edwin C. Kelton succeeded General Hannum as Pacific Division Engineer. In January, 1944, Colonel Kelton moved the Pacific Division Office back to San Francisco and established it in the Balfour Building on California Street. Following the war, on

March 5, 1946, the North Pacific and South Pacific Divisions were re-established (General Order No. 3, Office Chief of Engineers).

The Secretary of the Debris Commission for the entire war period continued to be appointed from the ranks of the Sacramento District. Colonel Robert C. Hunter served in this capacity for the entire period.

1945 Colonel Edwin C. Kelton, President
Colonel Robert C. Hunter, Secretary
Colonel Rufus T. Putnam

1946 Colonel Edwin C. Kelton, President to May 31, 1945
Brigadier General Phillip G. Burton, President, December 8, 1945, to March 11, 1946
Colonel E.H. Marks became President on April 11, 1946
Colonel Hunter was replaced on December 8, 1945, by Colonel Lester F. Rhodes
Colonel Rufus T. Putnam served until February 1, 1946

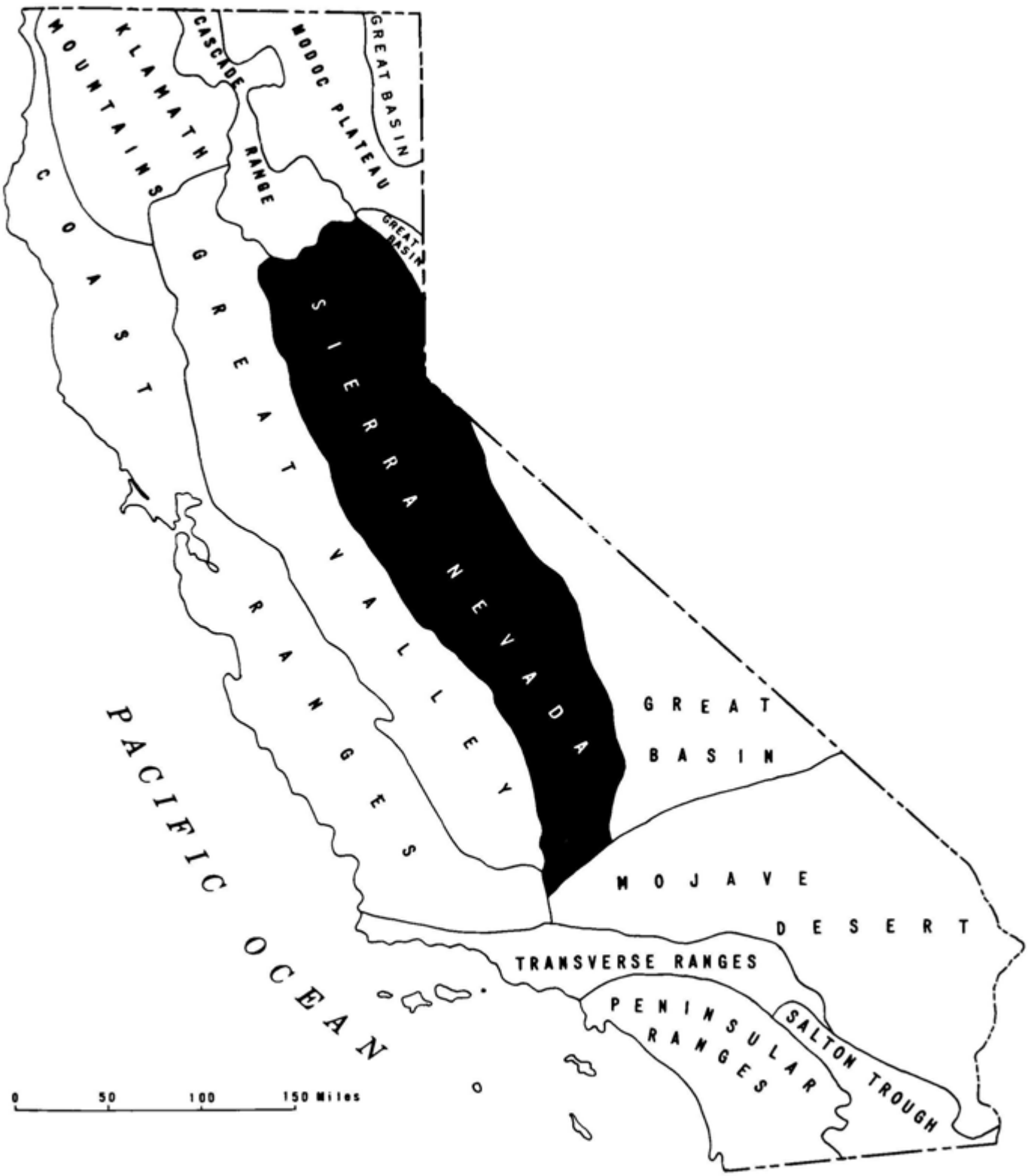
1947-1950 Colonel E.H. Marks, President to June 1, 1947
Colonel Dwight F. Johns, President from June 1, 1947, to December 31, 1949
Colonel Lester F. Rhodes, Secretary
Colonel George Mayo, August 8, 1946, through May 13, 1947
Colonel S.N. Karrick from May 13, 1947
Colonel Joseph S. Gorlinski replaced Colonel Rhodes as Secretary on August 24, 1947
Colonel Gorlinski served as Secretary to March 31, 1950
Colonel Karrick served as a member to July 31, 1949

1951-1953 **Presidency** of the Commission was vacant from July 1, 1950, to November 27, 1950; Colonel John S. Seybold, President, November 28, 1950, to May 14, 1951. Vacant from May 15 to June 30, 1951
Secretary - vacant July 1, 1950, to November 28, 1950
Colonel C.C. Haug, November 29, 1950, to June 30, 1953
Member - Colonel Walter D. Luplow, July 1, 1950, to November 30, 1950; vacant December 1, 1950, to February 25, 1951; Lieutenant Colonel William R. Shuler, February 26, 1951, to June 30, 1951
President - vacant, July 1, 1951, to September 24, 1951
Colonel D.S. Burns, President, September 25, 1951, to January 1, 1953
Vacant - January 2 to April 19, 1953
Colonel Paul D. Berrigan, President, April 1953 to January 2, 1955

1953-1955 President: Colonel Berrigan
1953-1955 Secretary: Colonel W.L. Ely
1955-1956 Secretary: Colonel A.D. Wilder
1953-1954 Member: Colonel A.J. Goodpaster
1954 Member: Colonel W.F. Cassidy
1954-1957 Member: Colonel John A. Graf
1955-1958 President: Brigadier General W.F. Cassidy
1956-1959 Secretary: Colonel A.E. McCollam
1957-1960 Member: Colonel John S. Harnett
1958-1961 President: Brigadier General Robert G. MacDonnell
1959-1960 Secretary: Colonel H.A. Morris
1960-1963 Member: Colonel John A. Morrison
1961-1965 President: Brigadier General Arthur H. Frye, Jr.
1960-1963 Secretary: Colonel Herbert N. Turner
1963-1966 Member: Colonel Robert H. Allan
1965-1967 President: Brigadier General Ellis E. Wilhoyt
1963-1966 Secretary: Colonel Robert E. Mathe
1967-1968 President: Brigadier General W.M. Glasgow
1966-1968 Secretary: Colonel Crawford Young
1966-1969 Member: Colonel Frank C. Boerger
1969-1972 President: Brigadier General Frank A. Camm
1968-1970 Secretary: Colonel George B. Fink
1969-1972 Member: Colonel Charles R. Roberts
1971-1974 President: Brigadier General George B. Fink
1970-1973 Secretary: Colonel J.C. Donovan
1972-1974 Member: Colonel James L. Lammie
1974-1977 President: Brigadier General R.M. Connell
1973-1976 Secretary: Colonel F.G. Rockwell
1974-1977 Member: Colonel Henry A. Flertzheim, Jr.
1978-1980 President: Brigadier General Norman G. Delbridge
1976-1979 Secretary: Colonel Donald M. O'Shei
1977-1980 Colonel John M. Adsit
1980- President: Brigadier General Homer Johnstone
1979-1980 Secretary: Colonel Paul F. Kavanaugh
1980- Member: Colonel Paul Bazilwich, Jr.

Chapter I

Geology of the Northern Sierra Nevada



Just as the California Debris Commission is a unique organization within the framework of the Corps of Engineers structure, so too is the geology of the area over which it has jurisdiction. To fully comprehend one, it is necessary to be conversant with the other.

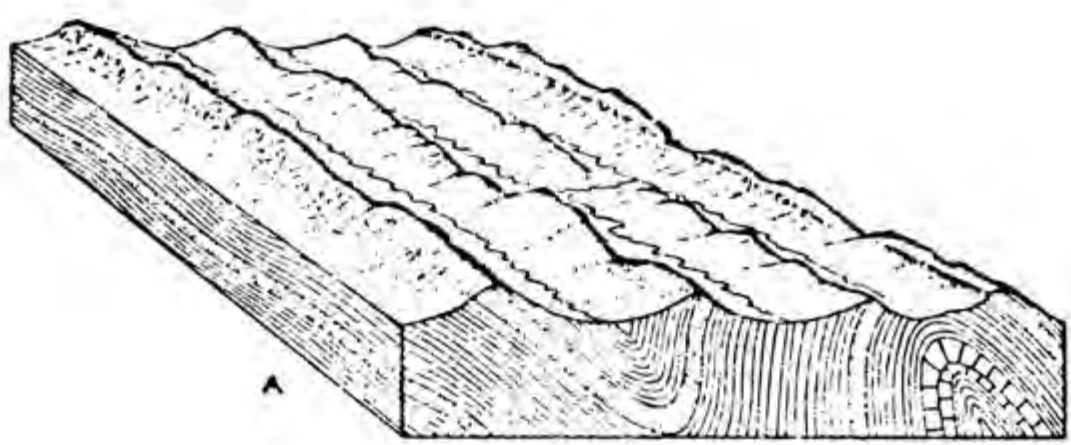
Of the eleven geomorphic provinces within California, the Sierra Nevada mountain range stands dominant, both figuratively and physically, above all others. Operations of the Commission have been limited to the northern sector of the range known as the Sierran Gold Belt, extending roughly from Mount Lassen in the north to the Yosemite Valley in the south. The drainages in this region empty primarily into the Sacramento and San Joaquin Rivers, and this sector along with the rivers themselves form the heart of the Commission's geographic limits of responsibility.

During much of the Paleozoic and most of the Mesozoic eras, a great sea covered the area now occupied by the Northern Sierra. Near the close of the Mesozoic era, sediments from this sea were faulted, compressed and folded. Emplacement of granitic plutons forced the compressed mass upward, forming high peaks with veins of gold-bearing quartz filling fissures and joints of the granitic rocks and of the altered sediments.

Early in the Cenozoic era (the present geologic era), what is now the Sierra Nevada was little more than a series of troughs and basins between ridges whose tops had been so eroded as to be almost inconspicuous. Erosion continued to plane down the mountains and release gold-bearing quartz which was further fragmented by stream action and deposited along the river banks as auriferous gravels. With the passage of time the topography of the range was reduced to comparatively gentle outlines while deep rock decay promoted the liberation of gold-bearing quartz.

Renewed uplifting, known as the Tertiary Sierran Uplift, hastened the erosion process and facilitated the continuing deposition of gold. This long period of erosion laid bare the upper, richer parts of the gold-bearing quartz veins and eventually resulted in releasing, removing, depositing and concentrating the gold from the veins into placer deposits of unbelievable richness.

The gold-releasing episode was a time of geologic quiet, not one of the violent earth movement and mountain building. It began during the Paleocene epoch when the climate was semi-tropical and humid and continued into the Eocene. This environment contributed to deep weathering, resulting in the formation of red lateritic soils such as are found in the tropics. During the weathering and erosional processes, clay was formed and then deposited along with decayed vegetation to form lignite (soft brownish black coal). The quartz, however, did not break down with the feldspar but remained as fragments, pebbles and sand. In places these were cemented together by iron oxide weathered from the rock. In this way the gold in the veins was separated from its matrix and released. Because of its high specific gravity, the gold found its way into the lower parts of crevices and into the beds of streams where it became lodged in the natural rock-riffles of the slate and schist. These Eocene streams were the water courses of 50 million years ago and were to be preserved until a much later time by the volcanism of Oligocene and Miocene times. Fine, light-colored volcanic ash and



A. Block diagram illustrating Cretaceous Sierra Nevada topography. The upturned edges of bedrock controlled the drainage pattern, which was later inherited by streams of the early Eocene period. *After Matthes, U.S. Geol. Survey, Prof. Paper 160, 1930.*

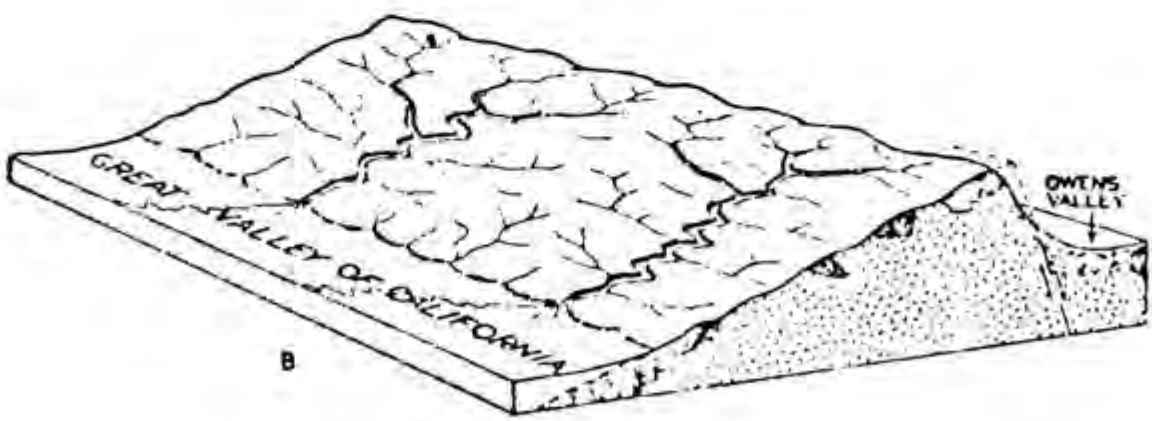
darker colored andesite flowed or was washed into the streams where it created dams, formed and filled lakes, and diverted some drainages. The volcanism continued to grow even more violent and was accompanied by earth movements and severe earthquakes.

It is generally held that the earthquakes of this period must have been of tremendous intensity, the result of great earth movements and faulting which prevailed during the late Pliocene and early Pleistocene. The Sierra Nevada province moved largely as a unit, tilting westward and breaking along the eastern escarpment. This uplifting and tilting of the range accelerated the flow of the streams down the western slope of the mountains, cutting deep and rugged canyon. Of singular importance is the fact that the westward tilting and resulting stream flow acceleration interrupted the drainage system inherited from th earlier epochs. The readjustment of the streams resulted in their general direction of flow being changed to a westerly course, much like the pattern of today.

Within the Sierra Nevada range, the continuity of the buried Tertiary stream channels was broken by faults, and as a result many of the ancient channels were virtually cut into many pieces. As the new canyon-cutting streams destroyed the older channels, great quantities of gold were freed and then concentrated in the new canyons. Adding to these concentrations were the weathered gold-bearing quartz veins that were also being uncovered.

The Pleistocene epoch has been called one of the most remarkable times in the earth's history. For in addition to faulting, uplifting, canyon-cutting and resurrection of the ancient channels and old Tertiary surfaces, the epoch was also the time of the great glaciers. There were four continental glacial and interglacial stages, but perhaps only three occurred in California. Beginning about a million years ago, glacial action began to erode the higher peaks and to carve out the principal valleys and lake basins. Some of the most famous results of this action can be viewed in the spectacular features of Yosemite Valley. Geologically speaking, the glacial period lasted for a relatively brief time, but the cutting and shaping actions of the glaciers helped free the gold from its surrounding matrix. This then was also washed into the stream channels.

In summary, the shapes and forms of the Sierra Nevada are the result of stupendous geologic processes. The western slope has been dissected by rock-walled canyons of exceeding depth, cut by mountain rivers flowing westward to the Great Valley. Moreover, these canyons often reach to the very core of the mountains, and by doing so expose the ancient stream channels to view and exploitation. Finally, the structure of the interrelated channels is complex, and for that reason the distribution of the gold within them is variable. The story of these is closely interwoven with the earlier history of the bedrock, the position of the gold-bearing veins in the bedrock, and their removal and redeposition by erosion. In the end it would be the sand and gravel from these ancient channels, washed as they were into the navigable streams of the valley, that would provide the motivation for the formation of the California Debris Commission.



B. Block diagram to show tilting of the Sierra Nevada and its effect on stream cutting. Erosion, prior to the tilting, planed down the surface and exposed the granite, leaving only occasional fragments of the intruded metaphoric rock-bodies as roof pendants. The streams, at the point where they leave their mountain canyons and enter the Great Valley, form alluvial fans. *After Matthes, U.S. Geol. Survey, Prof., Paper 160, 1930.*

Chapter II

Mining by the Hydraulic Method

During the last several thousand years the Sierra Nevada has remained as it is seen today. To be sure, the same geologic process of upheaval and subsidence that created the range continues, but few people have cause to notice the minor earth shocks that occur daily. Only when homes begin to shake and jars tumble from shelves are we reminded that the basic forces of natural change are still at work. Even so, until the mid-nineteenth century the area remained a rugged and peaceful wilderness.

With James Marshall's gold discovery of January 1848, and the subsequent rush of the following year, the primeval stillness of the mountains was shattered forever. Initially the argonauts worked the readily available alluvial deposits with simple tools — pans, shovels, picks and a variety of elongated boxes known variously as rockers and Long Toms. In truth, whatever a man could carry about with him, or manufacture at his claim, usually proved sufficient to reclaim the available gold supply.

Once the rich river bars were worked to exhaustion, the miners' attention was naturally turned to the river bottoms. To work these, streams were dammed and turned into new channels, often at enormous costs and high risks. The beds of rivers were laid bare for considerable distances while the miners worked their claims. This type of mining, apart from the danger arising from floods and the breaking of dams, contained a large factor of uncertainty. The value of the claim could only be ascertained after all the major expenses had been incurred. The losses in several instances were substantial. In other cases the gains obtained in but a brief span of time were so enormous that there was no shortage of adventurers willing to risk life, limb and bank account in an effort to cash in on this source of gold.

During the early history of gold mining in California, the major portion of the precious metal was procured from the placers or surface washings in the river bars and beds, and in the gulches and canyons situated near streams. For many years an enormous yield was maintained from these sources. Gradually, however, as

In this composite early gold-mining scene, one miner operates a horse-powered arrastra, a second pans ore, and a third works with a rocker.

was to be expected, the area available for this kind of mining was narrowed as ground was worked out. Attention was then turned to other sources of gold supply.

Finding as they did that gold-bearing deposits occurred only at certain locations, the miners searched nearby for the source of the free placer gold. While doing so they accidentally discovered the gold-bearing Tertiary river channels that were buried deep within the canyon walls, often several hundred feet above the present day streams. To work these ancient river beds, the overburden had to be removed. At first they relied on the slow but proven method of using picks, shovels and wheelbarrows to get at the rich deposits. Once there, they would wash them in the traditional methods.

Before long the miners discovered that water would do much of the preliminary work for them. A simple dam was thrown across a stream to divert the water over the area to be mined. The flow would wash away the lighter overburden, leaving the gold-bearing gravels more readily accessible to be worked by any of the simple methods of placer mining.

Soon this method was improved upon by what has become known as gouging. The term is almost self-explanatory, in that a rough trench was gouged into the area, water was directed over the material to be worked, causing the lighter soils to be carried away and leaving the heavy gravels to collect on the trench bottom.

Gouging soon gave way to ground-sluicing and booming. Ground-sluicing consists of treating the gold-bearing gravel, which is excavated by pick and shovel, by washing it in trenches cut in bedrock. It is similar to hydraulic mining, except that the water is not used under pressure and often no wooden sluices were employed below the trenches. Rough natural rock again served as riffles to catch the gold.

Booming was simply ground-sluicing on a large scale, the only difference being that instead of washing the gravel by means of a continuous stream of water, the contents of the entire reservoir were discharged at once and all the material which had been collected below it was swept into the sluices. The sudden rush of water carried off the boulders and dirt, leaving behind the heavy particles of gold and magnetic iron sands, which collected on the bedrock floors. In all cases, whether gained by gouging, ground sluicing or booming, the material still had to be worked in Long Toms or pans to secure the gold. Each of these methods, and variations upon them, proved highly successful and were practiced extensively.

Sluicing revolutionized gold-washing. Its introduction changed both the character of mining and the character of the mining population. The deep deposits of gold-bearing gravel were relatively poorer than the shallow placers, and open cuts preparatory to sluicing were requisite. Coincident with the advent of the sluice in 1851 came the employment of hired men in the placer diggings. The days of the independent miner working a claim alone were numbered. Over the years the majority of the miners gradually stopped working for themselves, and were employed by companies for daily wages.

It became readily apparent that the sluices ran dirt faster than the shovellers could supply it. Moreover, labor was expensive — men received six to eight dollars per day — and the claims were poor when compared with the washings of 1849-50. It also became obvious that if profits were to be made, an improved method of extracting the gold would have to be found.

There seems to be a dispute as to who actually discovered the better way to handle the situation. Some claim that in April 1852, a Frenchman by the name of Antoine Chabot dug a ditch at his gold claim on Buckeye Hill near Nevada City to bring water to the area so that he could wash gold dust from the gravel deposits. The water flowing in the ditch quickly cut down to the rough and uneven bedrock. Supposedly Chabot saw that his ditch had as fine a set of natural riffles to catch the gold as any man-made device then in use. To help the process along he shoveled gravel into the ditch where the water could be of even greater benefit. It has been reported that Chabot was soon counting as much as $120 in his daily cleanup, while other miners were getting only an average of $20. From there, it was a logical step for Chabot to devise a means of eliminating the hard work of shovelling. The story goes that he attached a length of canvas hose to the end of the small flume at a point above his claim. By directing the resultant flow against the gravel banks, he washed the earth, sand and rock into the sluice, and increased his daily earnings to $1,000.

If this account is true, we must regard Antoine Chabot as the father of hydraulic

Early placer mining scene in 1852, at what is now Nevada City.

The early-day photo shows the terrible power of even a relatively small hydraulic appliance. (Corps of Engineers photo)

mining, and thus a close relative to the California Debris commission. Mr. Chabot's subsequent activities certainly suggest that he had both the imagination and intelligence to devise such a scheme, for he grew wealthy from his mining ventures, and repaired to the San Francisco Bay Area a rich man. This is reflected by the fact that he developed the beginnings of San Francisco's first water supply system by damming Lobos Creek. He also built water systems for Vallejo, San Jose and Oakland.

Equally reliable sources suggest that it was Edward E. Mattison of Connecticut who first stumbled upon the hydraulic mining process. According to the story, Mattison, or one of his partners, fabricated a rawhide hose, attached a crude wooden nozzle, and commenced washing gravel down from the hillsides and into a sluice.

Yet another version has Chabot manufacturing a hose for Mattison, while Mattison's partner, Eli Miller, put together a primitive tapered nozzle and attached it to the hose. The other end of the hose was secured to a barrel which served to regulate the flow of water coming from Chabot's penstocks. Finally, together they directed a jet of water against the bank.

Inasmuch as most historians agree that (1) the method was first developed near Nevada City and (2) that both Chabot and Mattison were there in 1852-53, it is very likely that one or both perfected the method and used it before anyone else. Whatever the case, the directing of water under pressure against a bank of gold-bearing gravel was first used near the banks of the Yuba River within a few years of Marshall's history-changing discovery. It was also the next step in the saga that ended with the creation of the California Debris Commission.

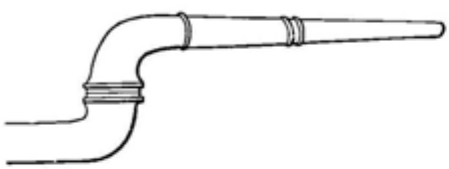
The new gravel-washing method couldn't be kept secret for long. Soon others learned of Chabot and Mattison's spectacular success and began to employ like methods throughout the Northern Sierra. Initially canvas hose was used extensively. As greater pressures were achieved it became necessary to strengthen the canvas with rope and wire netting. Before long, however, a technological barrier was reached in that canvas, regardless of how it was supported, could be made to handle only so much pressure before bursting. Moreover, great quantities of water were required for the hydraulic mining process. Thus, if continued advancement was to be made, new, larger and more reliable delivery systems would have to be established. For at about the same time that canvas had reached its limit of service, so did the rudimentary systems that fed the early placers. Finally, because relatively poor deposits could be worked cheaply by the hydraulic process, many new claims were established, putting still more strain upon the existing water supply. Thus it was that hydraulicking revolutionized the mining industry and gave birth to a wide variety of support services created expressly for the new industry.

One of the first of these concerned the replacement of canvas with metal. Towards the end of 1853 pipes made of light sheet iron were introduced. The first iron pipe was used by R.R. Craig, on American Hill, Nevada County. It consisted of about one hundred feet of stovepipe. In 1856 a firm in San Francisco began to manufacture wrought iron pipes for hydraulic mining, and during the years 1856 and 1857 a large sheet iron pipe, forty inches in diameter, was laid for a water conduit across a depression at Timbuctoo, in Yuba County.

With the substitution of sheet iron pipe for canvas, it was found necessary to retain a short piece of canvas hose to provide a flexible discharge piece so that the water could be aimed in the desired direction. This proved inconvenient, troublesome and occasionally dangerous, owing to the higher pressures being utilized. Again necessity proved the mother of invention when a nozzle called the "Goose Neck" was introduced. The "Goose Neck" was a simple iron joint formed by a pair of elbows working one over the other with a coupling joint between them. Even though this was a significant advancement in the state of the art, "Goose Necks" were clearly not the final answer. The pressure of the water often made the joint hard to move, and when the pipe was turned horizontally it was apt to "buck" or fly around in a contrary direction. The same situation occurred when elevating and depressing the pipe. This problem was overcome to a major degree when C.F. Macy patented the radius, or rifle, in 1863. This was subsequently introduced and used in all metallic jointed discharge pipes which had elbows. This vane-like device was inserted into the discharge pipe which prevented the rotary movement of the water caused

by the elbows and forced it to issue in a straight line, concentrated and in a solid form. The rifle also made the pipe a more stable instrument to handle.

The "Goose Neck" was improved upon by the invention of the Craig Globe Monitor, a simple ball and socket joint. Still this



Goose Neck Nozzle

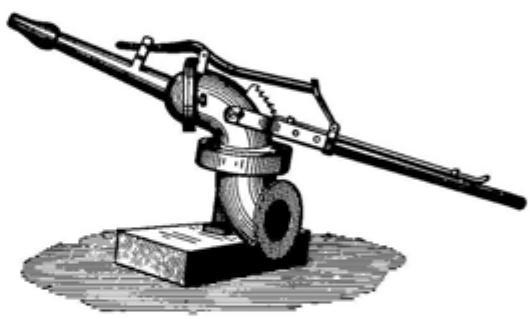
was hard to manage, often requiring several men to operate it. Craig later modified his Globe Monitor by building into it a small tripod with a center having a hole to take a bolt with a knob on the end. The other end of the bolt passed out through the top of the elbow and attached to a lever secured by a nut. By tightening the nut-lever device, the strain on the joint was reduced, making the nozzle easier to turn. Even with this addition, the machines were leaky and hard to control.

The Craig Globe Monitor was soon outdated by an invention perfected by F.H. Fisher of Nevada County. Called the "Hydraulic Chief" but also known as the knuckle-joint and nozzle, the device consisted of two elbows placed in reversed position when in right line, connected by a ring which contained anti-friction rolls. The ring was bolted to a flange on the elbow, but allowed the upper elbow to move freely in the horizontal plane, while vertical movement was obtained through the knuckle-joint which was placed in the outlet on the top elbow. This joint was simply a concave surface fitted to a convex one, the former having an opening for the pipe to pass through. The interior of the "Hydraulic Chief," unlike the Globe Monitor, was unobstructed by any bolts or fastenings, and a single miner could operate it with little difficulty. On the other hand, these also leaked quite badly and were expensive to keep repaired.

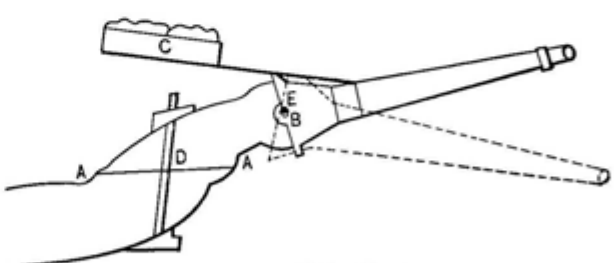
The "Hydraulic Chief" was pushed to the background in 1870 when Richard Hoskins patented his "Hoskins Dictator." This was a single-jointed machine, having elastic packing in the joint instead of two metallic faces fitted one to the other. The joint worked up and down on pivots, and in rotating it, the wheels ran around up against the flange.

A few months later Hoskins invented the "Little Giant" — a two-jointed device which soon replaced all others in the mines. It was simple, durable, portable and easily handled. All the "Little Giants" had rifled barrels and used nozzles from 4 to 9 inches in diameter.

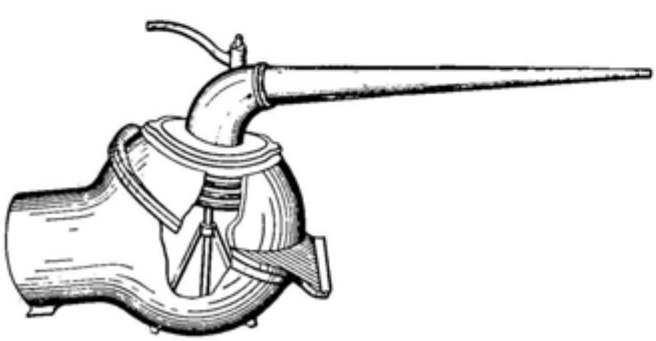
Further modifications were made to the "Little Giant" by manufacturing firms located in Sacramento, Stockton and San



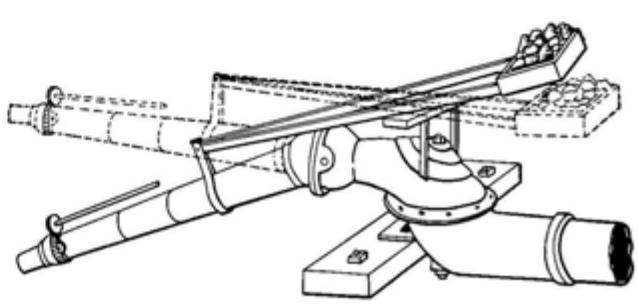
The Hydraulic Chief



Little Giant



Craig's Globe Monitor



Hydraulic Giant

Francisco, but in the main these changes were limited primarily to the size of the machines. The generic name applied to these latter water cannons was "Hydraulic Giant." Some weighed as much as a ton and more, and in the end became the definitive instrument for washing down the mountains.

The only significant improvement to these massive, water-powered siege guns was made in May 1876, when H.C. Perkins patented his "deflector." This was a short piece of pipe, about an inch larger in diameter than the nozzle, attached to the latter by a gimbal joint and operated with a lever. By moving the lever the deflecting nozzle was brought into contact with the stream of water and thus exerted pressure upon the entire "giant." The force of water striking the nozzle changed the course of the stream, thus moving the "giant" in any desired direction.

A further modification to the idea of the deflecting nozzle was the invention of the "Hoskins Deflector." This was a flexible semi-ball joint placed between the end of the discharge pipe and the nozzle. It was also operated by a lever. Supposedly it was easier to work and less dangerous for the miners to operate.

This then was the essential piece of equipment required to carry on hydraulic mining. It was not the only one, however, because hydraulicking was prosecuted in a variety of settings, often on a 24-hour basis. A frequent problem encountered was the obstruction of the work by huge boulders. Strong derricks set on the bedrock and having masts 100 feet high and booms of more than 90 feet were common in most of the larger operations. The mast was held in place by half-dozen guys of galvanized iron wire rope, an inch in diameter. A whip block, with three-quarter-inch diameter steel rope, was used for the hoisting tackle. Twelve-foot diameter impact wheels were attached, using 30 inches of water under a 275-foot-head, to lift stones weighing as much as eleven tons. The guys, in turn, were held by double capstans. Reports indicate that these derricks could be moved as much as 100 feet in the space of ten hours without being dismantled.

When conditions were favorable, hydraulicking was carried on round-the-clock, necessitating the use of artificial light. At first, pitch wood fires were used. In time these gave way to large locomotive headlamps and primitive electric lights. The latter were operated by the same types of impact wheels used to power the derricks. Known locally as hurdy-gurdy wheels, these large impact-type water wheels moved by means of a stream or jet of water issuing under pressure from a conical nozzle and striking open buckets on the circumference of the wheel. The buckets, originally flat, were later modified

Relics of the past lie rusting in the old mining town of Cherokee, Butte County. (Author's photos, 1980)

"Giants" and "Monitors" found at the Plumas County Museum in Quincy, California, remind visitors of the dozens of mines that once operated in Plumas County. (Author's photos, 1980)

and made in a curved fashion so as to improve their efficiency. While the miners referred to these types of wheels by the colorful "hurdy-gurdy" terminology, their manufactured names were listed variously as Fredenburr, Pelton, Knight and Taylor wheels.

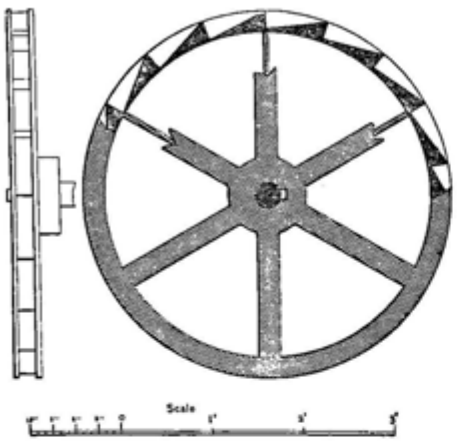
Not only were improvements made in the devices required to blast the enriched gravels from the mountainsides, but improvements were made in the actual gold recovery equipment as well. In the case of hydraulicking this meant bigger and better sluice boxes. In the early days of placer mining, sluices were usually only a few feet long. Over the years, however, they too grew in proportion to the expansion of the industry as a whole. By the time hydraulicking reached its zenith, sluices were hundreds and often thousands of feet in length, for the longer the sluice, the higher percentage of gold recovered.

Accompanying the development of these larger and longer sluices were a pair of difficult problems. On the one hand the gravels being worked were tightly compacted and cemented together. Even with the tremendous power of the "monitors" and "giants" being played against them the banks held firm. This barrier was overcome by the introduction of black powder and later dynamite into the mines. Shafts (drifts) would be dug into the banks, stuffed with explosives and then blasted loose. Sometimes half a million cubic yards of the clay, sand, gravel and large rocks would be loosened at one time. Once freed the material would be washed until it had been rendered as small as possible before being pushed into the sluices by the torrents of water.

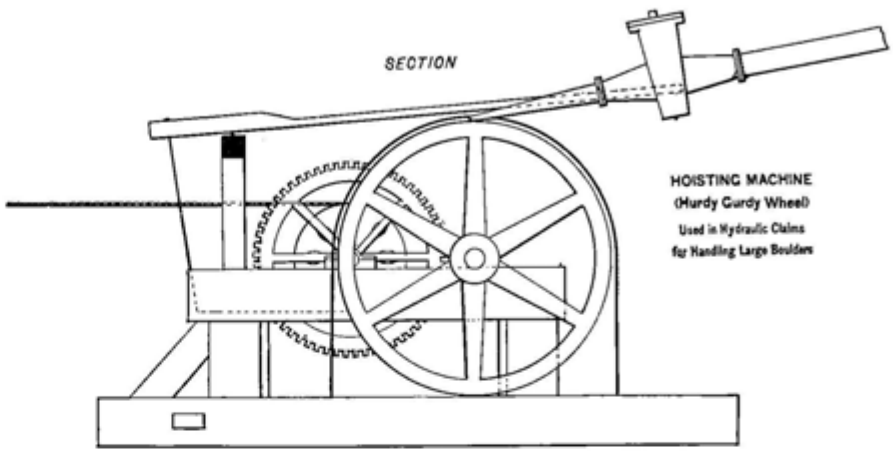
All of this led to the second problem. Hydraulic mining produced such vast amounts of tailings that the smaller mountain streams simply could not carry away the huge amounts that accumulated in their beds. Several mines in fact had to be shut down by the late 1860s because they lacked adequate means to dispose of the waste material they created. Once again, however, solutions were found to the problem.

Machines were developed to both assist in working various types of gravels and to rid the mines of debris. They became known as hydraulic gravel elevators. The principle upon which these operated was based on the notion of driving gravel uphill by hydraulic force. It was only necessary to give the impelling water more velocity than it ordinarily had while flowing through a flume to make it acquire sufficient force to carry gravel up an inclined plane. This fact suggested the construction of a machine which would direct and confine the inherent hydraulic force of a stream of water to impel masses of earth and stone before its power.

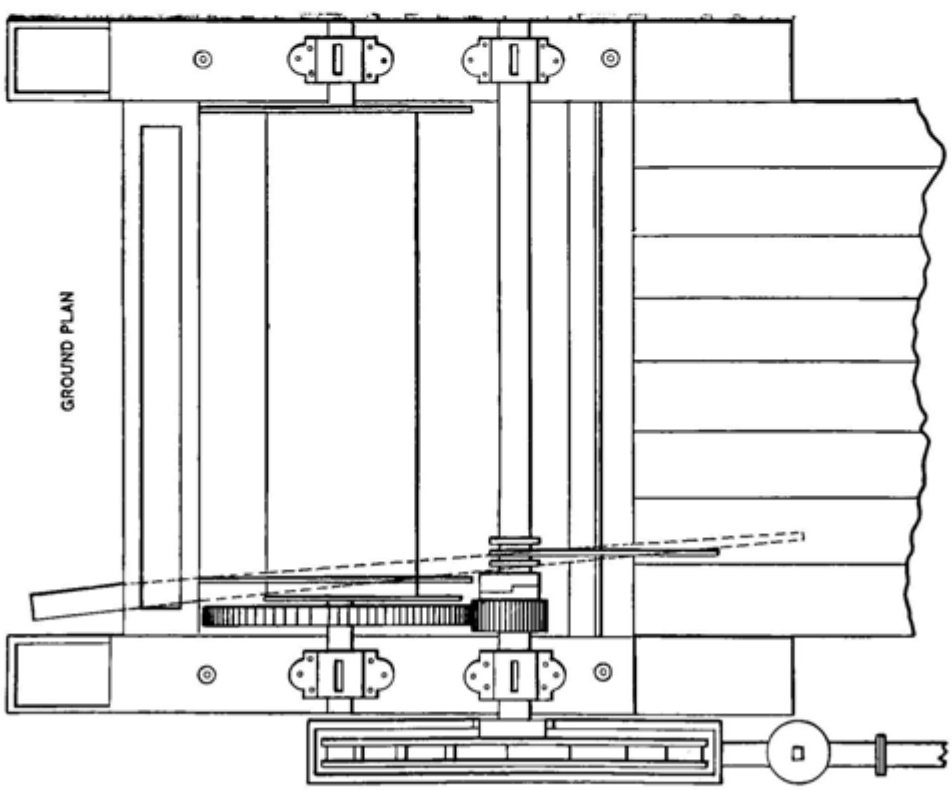
One of the more advanced versions of



HURDY-GURDY WHEEL.



HURDY-GURDY WHEEL AND DERRICK-HOIST.



HURDY-GURDY WHEEL AND DERRICK-HOIST.

this type of equipment was the "Evans Hydraulic Gravel Elevator." George Evans, a mining engineer, developed the machine while he was mining in New Zealand. Upon his arrival in California he modified and improved the elevator and introduced it into the Northern Sierra.

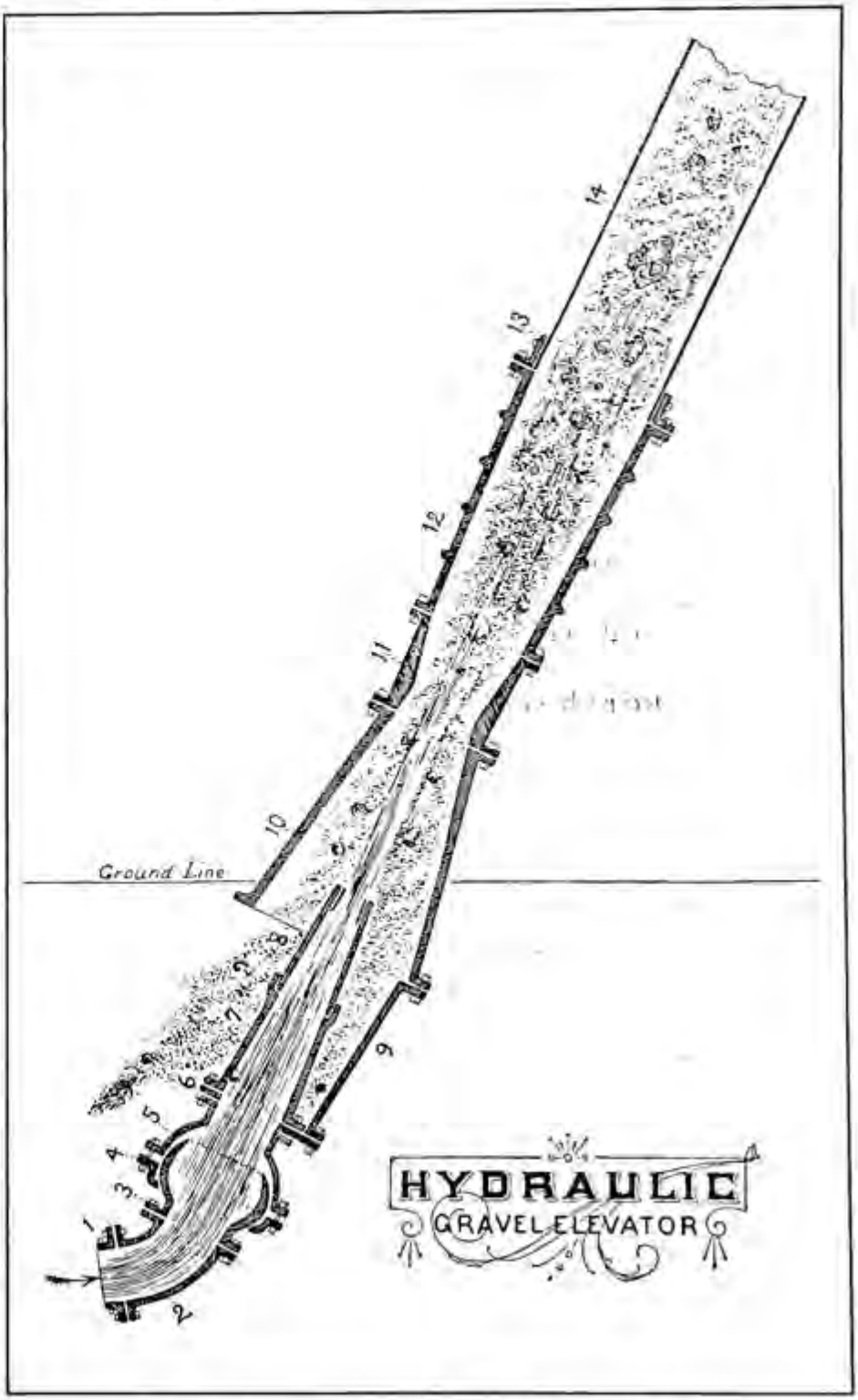
Its essential features consist of three suction pipes — a main suction and two auxiliaries. The auxiliaries were principally used to balance the intake, thus reducing the wear and tear of the machine. They also increased the efficiency of the elevator by allowing the proper proportions of air to enter when the water and material in the main opening became choked.

The elevators were similar in many ways to the other equipment used in hydraulicking. All the connections, such as main suction pipe, auxiliary suction pipes and water supply, were connected with swivel joints so that they could be adapted to a variety of connections, pipe sizes and working conditions. Interestingly enough it was an Evans Hydraulic Elevator that was used to pump water, not gravel, from the famous Comstock Lode in Nevada so as to prevent flooding of that mine.

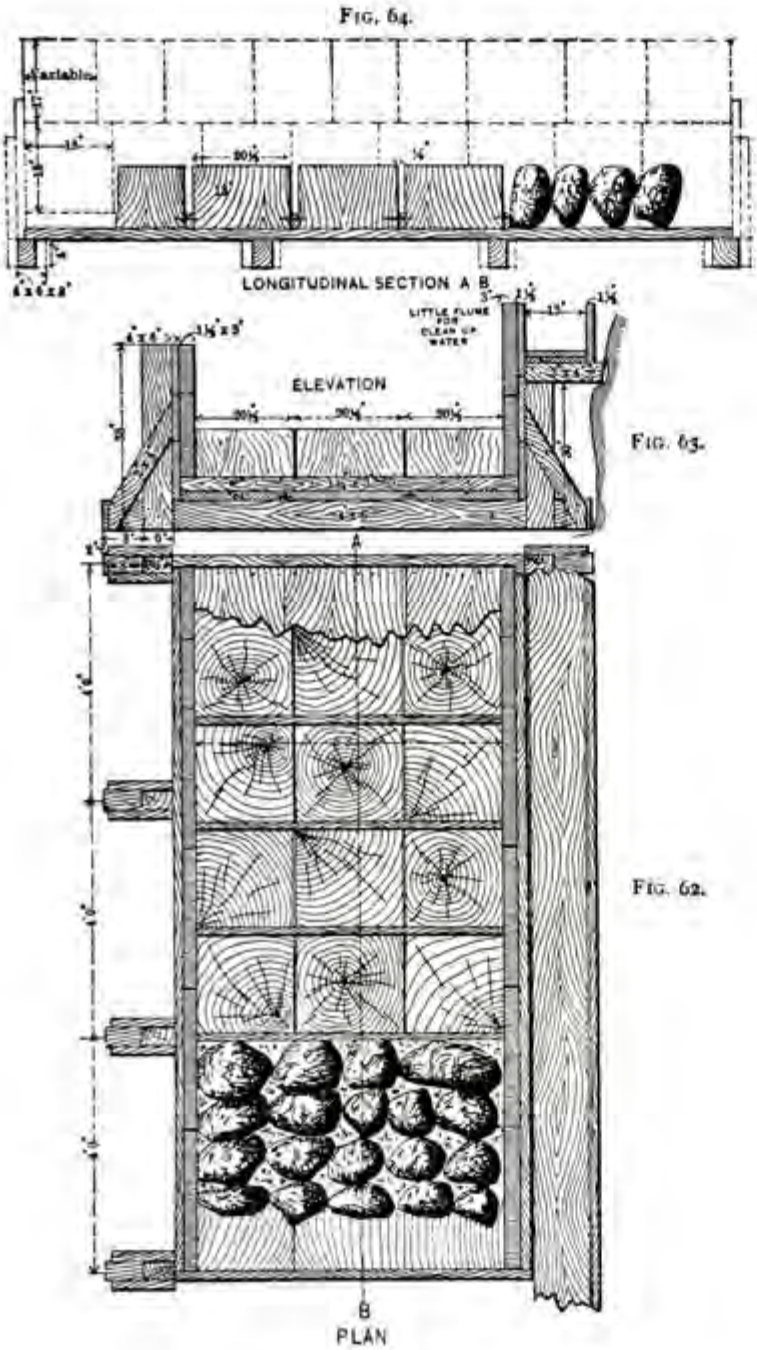
Yet another way to get rid of the mountains of debris and to extract gold from the gravel at the same time was to wash it directly into the major mountain streams via immense tunnels and sluices. This was accomplished by sinking vertical shafts to bedrock and then digging tunnels horizontally to the nearest river canyon.

Few individuals could gather sufficient capital for mining operations of this magnitude. To carry on these kinds of operations on a paying basis, stock companies were formed and set to the task that was beyond the scope of individual enterprise.

The classic example of this type of venture was the development of the North Bloomfield Gravel Mining Company. Moreover, the explorations of the North Bloomfield Company furnish a remarkable example of the extent to which preliminary work was done to determine the value of a claim(s) and the feasibility of working it (them). During the late 1860s Lester Robinson and his associates formed their company and made an initial investment of $350,000 in abandoned claims and water systems. They then sunk four prospect shafts to ascertain the value of the gravel, the position of the ancient river channel, and the depth to the bedrock. Once it was determined that the treasure was worth



Transverse section of the improved form of "Hendy" hydraulic gravel elevator.



Tunnel sluice box at North Bloomfield.

the trouble and effort to unearth it, they set to work building a tremendous tunnel that would allow them to extract the desired gold and at the same time provide a means of disposing of the resultant debris.

In his report to Congress for 1873, the government reporter Rossiter Raymond described the work at North Bloomfield.

> The tunnel, when completed, will be 8,000 feet in length. The mouth of the tunnel is 440 feet lower than the channel, and will, at the upper end, be about 75 feet lower than the gravel. A road was built by the company along the line of the tunnel, and eight hoisting-works put up . . . coming from the mouth of the tunnel. They are all built on the same plan, and are run by hurdy-gurdy wheels. The power is supplied from the company's reservoir, through 10,000 feet of iron pipe. The shafts are about 900 feet apart, and in all of them they are now sinking, and at the same time running the tunnel from the mouth . . . It is expected that the entire work will be completed in the spring of 1875.
>
> *Mineral Resources of the State and Territories West of the Rocky Mountains, Annual Reports 4 through 8, Wash., D.C. 1873, 1875, 1877.*

To complete this mammoth undertaking, Hamilton Smith, the company's chief engineer and superintendent, hired some 500 men and set them to drilling, blasting, digging and hauling. While drilling operations ran round the clock, hurdy-gurdy wheels spun, whined and roared as hundreds of sweating miners swarmed along the line of shafts which were being punched into the earth. In the end, a half-dozen bedrock tunnels would be opened and connected with vertical shafts to drain the mine. By the end of 1876, following years of doubt and toil — and the investment of millions of dollars in claims, water and construction work — the North Bloomfield was about ready to really start mining.

During the late 1870s the mine undertook uninterrupted operations. Approximately 100 men worked day and night in the hydraulic pit, along the ditches supplying the water and in the tunnels. At first the night work was illuminated by pitch wood fires and later by an electric light system.

To the uninitiated the working of a major

hydraulic operation was truly awe inspiring. A reporter from the San Francisco *Bulletin* visited North Bloomfield during the summer of 1879 and recorded his impression thusly:

> We stand on the brink of the mine and try to fix the salient points in thoughts and memory before we descend into the great amphitheater, vaster in its circle than the stony base of the Coliseum. Around us are naked rocks and well scraped furrows, piles of pine blocks for use in the flumes, rusting joints of condemned water pipe, and shops where soot-covered men are riveting joints of new pipe, (and) sharpening drills at glowing forges . . . As we turn to descend, a measured succession of sounds begins. Far down, under the highest cliff, on the sloping bedrock, and half hid in shadow, are a multitude of men. The water has done its work here, and washed out all the loose earth and small rocks . There is a real pleasure, very distinct, but hard to describe, about this gigantic force (issuing from the monitors and giants). This is the water which left the Bowman reservoir a few hours ago, and has been worried and tumbled and beaten into foam until one might easily believe that it comes out with not merely the force of much gravity, but also with a wicked, vicious, unutterable indignation. The black pipe, three feet in diameter, leads down the cliff, and across the mine. It becomes smaller, and ends in a jointed, elbow-like pipe, with a moveable nozzle . . . Large boulders and lumps of pipe-clay are slowly washed down to the bedrock for the blasters to handle, but rocks two feet in diameter fly like chaff when struck by the stream. The actual work of tearing down the cliff is hard to see, for there is a cloud of red foam hanging over the spot. You hear little rattling and slipping noises through the incessant roar, and a stream which seems ten times greater than could come out of the pipe, flows down the dripping pile, and so into the rock-channels which lead to the tunnel.
>
> Quoted in the *Nevada Daily Transcript* of July 30, 1879.

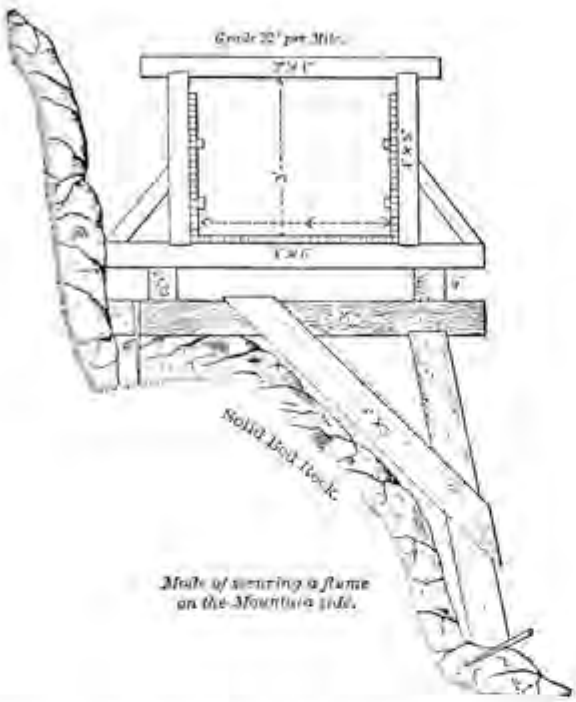
North Bloomfield was typical of the large mining operations on the Yuba River, just as the Gold Run Ditch and Mining company's hydraulic mine was of the corporate enterprises on the American River drainage. In the latter instance a group invested $900,000 to buy up claims, build water systems and excavate shafts and tunnels. At Gold Run a bedrock tunnel, begun during this same period, was to extend more than two thousand feet into the mountain until it reached an area two hundred feet under the level of the claim. A shaft was then to be dug to connect with the tunnel. Gravel would then be washed down the shaft, through the tunnel, and empty directly into the North Fork of the American River.

In such mines as these the vertical

Details of Work at No. 8 Claim, North Bloomfield Co.

	1874–1875.			1875–1876.			1876–1877.		
	Total.	Per cu. yd.	Per in. Water.	Total.	Per cu. yd.	Per in. Water.	Total.	Per cu. yd.	Per in. Water.
Cu. yds. Gravel moved.	1,858,000	....	4.8	2,919,700	....	4.17	2,293,900	....	3.86
Yield.....	$74,271 77	3.99 cts.	19.19 cts.	$192,735 73	6.60 cts.	27.53 cts.	$290,775 42	12.68 cts.	48.87 cts.
Expenses:									
Labor.....	$22,790 39	1.23 cts.	5.89 cts.	$40,975 85	1.40 cts.	5.85 cts.	$53,742 78	2.34 cts.	9.03 cts.
Explosives.....	2,944 94	0.16 "	0.76 "	10,279 73	0.35 "	1.47 "	25,376 16	1.11 "	4.26 "
Blocks.....	3,007 26	0.16 "	0.78 "	5,212 62	0.18 "	0.75 "	5,750 43	0.25 "	0.97 "
Material.....	5,663 89	0.30 "	1.46 "	9,250 46	0.32 "	1.32 "	10,158 72	0.44 "	1.71 "
Water	14,480 40	0.78 "	3.74 "	21,740 97	0.75 "	3.11 "	21,765 88	0.95 "	3.66 "
General.....	4,201 95	0.23 "	1.09 "	7,364 12	0.25 "	1.05 "	25,266 11	1.10 "	4.25 "
Total...	$53,088 83	2.86 cts.	13.72 cts.	$94 823 75	3.25 cts.	13.55 cts.	$142,060 08	6.19 cts.	23.88 cts.
Days' Run.....	295—com. Jan. 1, end. Oct. 14.			342—com. Nov. 13, end. Oct. 18.			318—com. Nov. 26, end. Oct. 13.		
Grade of Sluices.....	6½ inches to 12 feet.			6½ inches to 12 feet.			6½ inches to 12 feet.		
Height of Banks.....	180 feet.			260 feet.			318 feet.		
Inches of Water.....	386,972.			700,000.			595,000.		

COSTS OF WORKING AND THE YIELD OF GRAVEL.



Typical cross section of flume used by major mining and water companies. This is a diagram of one used by the Milton Mining and Water Company.

shafts were usually broken into terraces so that as the conglomerate fell, it would hit the benches and break up as completely as possible and facilitate the release of gold from its matrix. Once in the tunnel the muddy mixture passed through enormous sluices that frequently ran the full length of the tunnels and hundreds of feet beyond.

The size of the sluice and the particular components contained therein depended upon the grade, character of the gravel, the quantity of water available (and to be used) and to a significant degree upon the particular philosophy of the owners and their engineers. In general the larger sluices were 6 feet wide and 3 feet deep. As to length, the guiding principle was to build the appliance sufficiently long to ensure the most complete disintegration of the material, affording ample surface for the grinding of the cement, and the best facilities for the gold to settle in the riffles. In the final analysis, the length of the sluice employed was governed by its yield, the rule being to keep extending the sluice so long as the value of the gold recovered exceeded the expense of construction.

The bottoms of the sluices were lined with blocks of wood, stones, metal bars, wooden strips and a variety of other devices so as to trap the greatest amount of gold possible. To assist the natural workings of gravity and friction, quicksilver was placed on the bottoms of the sluices to capture the gold as it passed along and settled to the bottom.

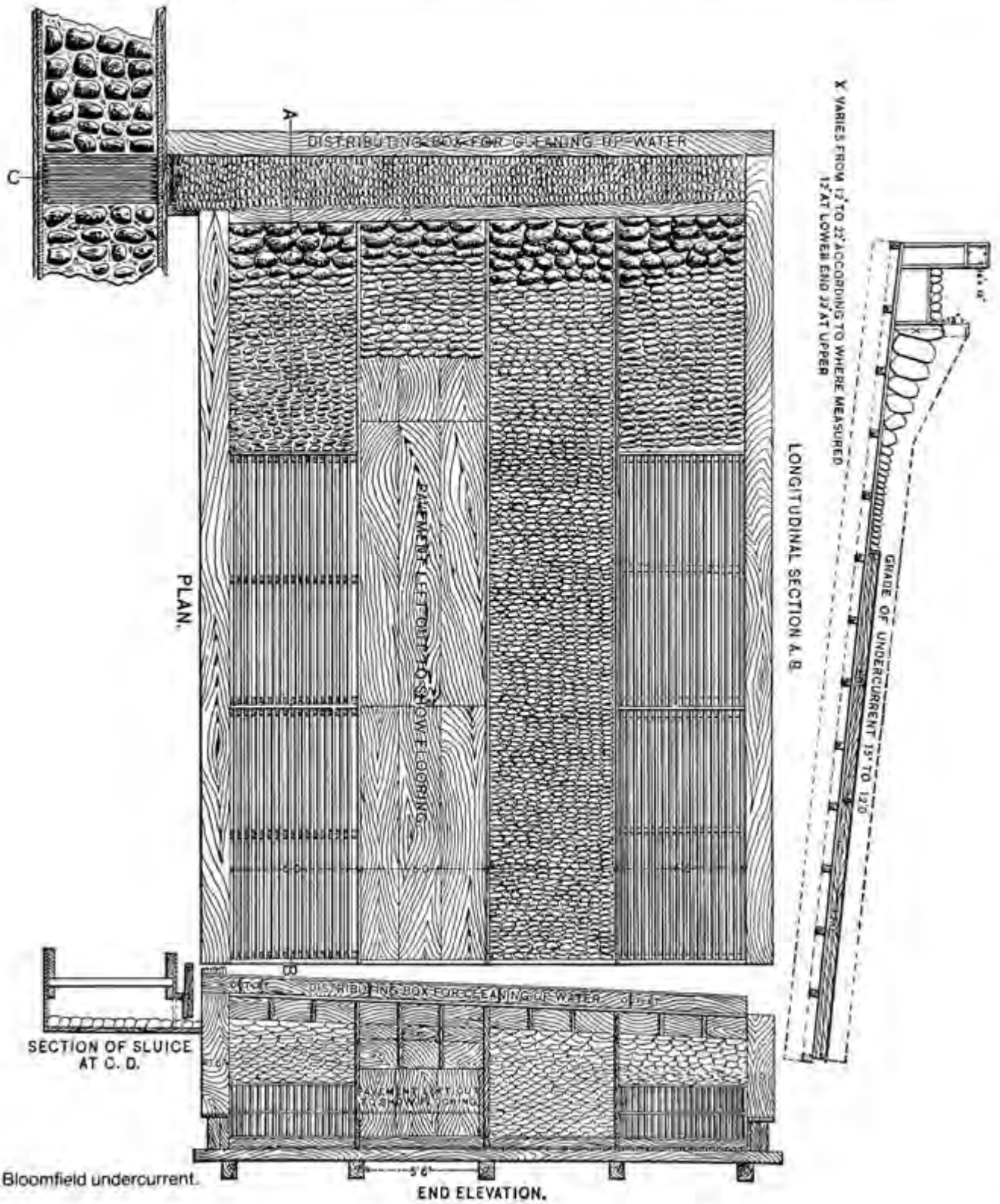
In order to relieve the sluices of the very fine gold and thereby ensure that it wasn't washed out, "undercurrents" were introduced into the sluice line. These were broad sluices set on a heavy grade at the side of and below the main sluice. When things worked as designed, the fine gold passed through a screen of steel or iron bars, called a "grizzly," and fell into a box about 20 inches deep, lined with blocks and set at right angles to the main line. This box carried the material to a chute at the upper end of the "undercurrent" and then to the "undercurrent" proper. This consisted of a shallow wooden box, 20 to 50 feet wide, and from 40 to 50 feet long. There the fine gold had a chance to settle out so that it could be reclaimed. About once each month the "monitors" and "giants" were turned off to allow the gold to be collected from the sluices. Usually a half dozen men would pull up the blocks, rails, stones and other gold-separating devices. At the same time a plank would be secured across the end of the sluice. Then a modest amount of water would be turned on, during which time the riffles would be scrubbed with brushes and brooms. In this way the gold would be pushed along to finally collect in front of the board, after which it would be shovelled into a container of quicksilver to be processed at a later time.

The entire hydraulic process — the "giants," the tunnels and the sluices — all depended upon the sure and abundant supply of water. By the 1870s the great companies formed to supply this critical ingredient rivaled in size and sophistication the large corporate mine companies. The modest ditches and wooden flumes of the 1850s had given way to a network of canals, pipelines, and water delivery systems that reflected the state of the art. By the late 1860s there were more than 5,000 miles of main pipelines and canals, and another 800 miles of branch ditches stretching across deep canyons, snaking along precipitous mountainsides and through tunnels to bring billions of gallons of water to the mines. These great delivery systems were fed in turn by hundreds of reservoirs, large and small, that trapped the falling rains and melting snows of the High Sierra.

Among the most important dams in California during this period were those built to create reservoirs for the hydraulic mining industry. Typical of these were Bowman Dam, height 100 feet, length 425 feet; three dams owned by the Milton Mining and Water Company, forming the English Reservoir, the largest of these having a height of 131 feet; the Fordyce of the South Yuba Canal Company, 567 feet long and 75 feet high; the Eureka Lake Dam of the Eureka Lake and Yuba Canal Company, length 250 feet, height 68 feet.

The Tuolumne County Water Company built several timber crib dams, the largest of which was put across the south fork of the Stanislaus River. This dam, which was 300 feet long and 60 feet high, rested for its entire base on solid granite bedrock.

The timber (log) crib dam was probably the most common type of dam built for hydraulic mining. Though they were built



North Bloomfield undercurrent.

to a variety of specifications, they were all generally constructed of round logs or hewn timber one to two feet in diameter, laid on each other so as to form in plan a series of cribs from eight to ten feet square, and pinned together by wooden pegs (treenails). In the better class of crib-work the timbers were notched and bolted to each other at each intersection with iron drift bolts, the round logs being flattened or notched where they lay one upon the other. The bottom timbers were bolted to the bedrock, and the ties were notched and bolted to the stringers. Once the entire crib-work was put in place, it was filled with stone. Finally the faces of the dams were made watertight by an outer skin of plank spiked to the face ribs, and then calked.

For smaller reservoirs, earthen dams were frequently used. Experience demonstrated that it was unsafe to build this type of dam to a height of more than 60 feet. Usually, earthen dams were constructed much lower than this, and were put up where conditions were favorable. It was generally held that the best combination of ingredients for earthen dams consisted of gravel, sand, and clay in just the correct proportions to provide sufficient weight, cohesiveness, stability and imperviousness.

It is worth noting that most hydraulic mining companies didn't believe that masonry dams justified the expense required for their construction. Hence, few of this type of dam were built exclusively for mining purposes. In practice, these were most often built if they could serve functions in addition to mining, such as irrigation and domestic water supply. Many of these, such as those that created Lakes Fordyce and Spaulding, are still being used for these purposes as well as for power generation.

On occasion, when a company was in need of additional storage capacity, the size of a dam was increased. An impressive example of this type of modification is illustrated by the main Bowman Lake Dam. Initially the dam was built in 1872 to a height of 72 feet. It was of timber crib construction and used unhewn cedar and tamarack logs These were notched and firmly bolted together, then solidly filled with loose stone of relatively small size.

During the years 1875 and 1876, when the North Bloomfield Company was expanding operations, the dam was increased to a height of 100 feet by filling in a stone embankment on the lower side of the old structure and faced with heavy walls of dry rubble stone. Above the 68-foot line, ribs of flattened cedar, eight inches thick, were built into the upstream face wall, and were tied to it by iron rods three-fourths of an inch in diameter and some five feet long. On to these ribs a planked skin was firmly spiked. The planking was made of heart sugar pine, three inches thick and eight inches wide, and was fitted together like the planks were on sailing vessels. In fact the planks were so well seasoned and fit together so tightly that no battening or calking was required.

RESERVOIRS

on the Yuba, Bear, Feather, and American Rivers, constructed for mining purposes.

Name.	Owner.	Capacity in cubic feet.
Bowman	*North Bloomfield Co.*	930,000,000
Shot Gun Lake	" " "	3,423,816
Island Lake	" " "	23,027,558
Middle Lake	" " "	2,395,800
Round Lake	" " "	2,907,630
Weaver Lake	*Eureka Lake Co.*	150,000,000
Eureka Lake	" " "	661,000,000
Faucherie	" " "	58,800,000
Jackson Lake	" " "	15,000,000
Smaller Lakes	" " "	50,000,000
English	*Milton Co*	650,000,000
Fordyce	*South Yuba Co.*	1,075,525,000
Meadow Lake	" " "	107,950,000
Sterling	" " "	53,975,000
Omega and Blue Tent	Blue Tent Co.	300,000,000
California	California Co.	600,000,000
El Dorado		1,070,000,000
Smaller reservoirs on the Feather, Yuba, and American rivers		700,000,000
Total storage		6,454,004,804

Dimensions and Costs of Ditches (including Flumes).

Name of Ditch.	Length. Miles.	Capacity. Miner's Inches.	Grade. Feet per Mile.	Dimensions in Feet.			Cost.	Remarks.
				Top.	Bottom.	Depth.		
North Bloomfield Main (and distributers)	55	3,200	12 to 16	8.65	5	3½	$466,707	Only 4,000 feet have a grade of 12 feet, but with increased area; the rest has a grade of 16 feet.
Milton	63	3,000	16 to 32	7.65	4	3½	462,998	
Eureka Lake, Main Ditch *	54	2,500	.....	.....	.....	.....	430,250	Smaller ditches and water-rights cost $89,227 additional.
Eureka Lake, Miner's Ditch	25	700	9.60	5	3	2	180,000	
San Juan, Main Ditch	32	1,236	9.60	6	4	3	292,992	
San Juan, Branches	13	700 to 1,300	9 to 16	6	4	3		
South Yuba Canal: Main Ditch, Upper Part	13½	7,000	17	8	8	6		This is a flume.
South Yuba Canal: Main Ditch, to head of Deer Creek	17	5,200	13	8	6	5		
South Yuba Canal: Main Ditch, from Junction with Dutch Flat Ditch	31½	.....	8	6	.....	4½		
South Yuba Canal: Dutch Flat Ditch	13	3,100	13⅓	8⅝	4	5		The South Yuba Canal Co.'s inch is measured through a 4-inch aperture in a 1½-inch plank, with a head of 6 inches above centre of aperture.
South Yuba Canal: Blue Tent Branch	13	2,300	13	6	4	4		
South Yuba Canal: Chalk Bluff Ditch	13	2,700	16	6	4	4		
South Yuba Canal: Cascade Ditch	15	1,600	12	5	4	4		
South Yuba Canal: Snow Mountain Ditch	.....	1,800	12	6	5	4		
South Yuba Canal: Total South Yuba Canal Co.	123	.....	.....	.....	.....	.....	2,190,000	
Blue Tent Co.'s Ditch	32½	1,800	10	8	6	4	250,000	Flumes are 5′ wide × 4′ deep. The inch has a head of 5 inches to centre of 2-inch aperture.
Excelsior Co.: China Ditch	33	1,700	9	8	5	4		
Excelsior Co.: Bowyer Ditch	15	1,200	13	8	4	3½		Smartsville inch 1.78 cu. ft. per min.
Excelsior Co.: Union Ditch	15	1,200	13	8	4	3½		
Excelsior Co.: Total Excelsior Ditches and Branches	—	5,000	.....	.....	.....	.....	1,200,000	
Hendrick's Ditch †	46½	.....	6.4 to 12.8	5 to 6	.....	2	136,150	Including Glen Beatson and Oregon Gulch Ditches.
Spring Valley and Cherokee	52	2,000	9.60	8	5	3½	500,000	
La Grange	20	2,400	7 to 8	9	6	3	450,000	
Tuolumne Co. Water Co. ‡	125	3,600	11 to 32	11 to 15	7½ to 11	4	.....	
El Dorado Co.: Main Ditch	27½	...	4	14	5	6	498,064 73	Excluding reservoirs. The water-rights cost $256,594 additional. Total cost of canals, reservoirs, and water-rights, $962,628 06.
El Dorado Co.: Branches	93	.....		9	4½	4	37,299 46	
California Water and Mining Co. ‡	250	.....	6 to 10	3½ to 8	2 to 5	1½ to 3	600,000	
Park Canal Co. ‡	290	.....	up to 16	8	5	2½	2,000,000	
Amador Canal Co., Main ‡	46	.....	8 to 10	10	6	4	900,000	The inch here is a discharge of 1.39 cu. ft. per min.
Amador Canal Co., Lateral ‡	75	...	16	8	5	4		

* Report of J. D. Hague. † Raymond's Report for 1873, pp. 73 and 74. ‡ Mint Report for 1881, p. 626.

Yield of Gravel at important Hydraulic Claims in California, according to verified Reports.

Name of Claim.	Location.	Cubic Yards Washed.	Gross Yield.	Yield per Cub. yd.	Height of Banks in ft.	Report of	Remarks.
				Cents.			
American Co.	Sebastopol, Nev. Co.	5,171,834	$1,241,240 30	24.	120	H. Smith, Jr.	
No. 8, 1870–74	North Bloomfield, "	3,250,000	94,250 00	2.9	150	"	Paid a profit of $2,232 84.
" 1874–75	" " "	1,858,000	74,271 77	3.9	180	H. C. Perkins.	
" 1875–76	" " "	2,919,700	192,735 73	6.6	260	"	
" 1876–77	" " "	2,293,938	290,775 42	12.7	265	"	
North Bloomfield	" " "	30,000,000	2,610,000 00	8.7	150–350	"	
French Corral	French Corral, "	4,200,000	1,745,500 00	41.5	20–100	"	The greater part of the top gravel had been removed previously.
Manzanita	Sweetland, "	5,780,000	1,489,000 00	26.	50–150	"	About one-third of the top gravel had been removed previously.
McCarty's	Columbia Hill, "	3,000,000	345,663 10	4.3		J. D. Hague.	
Sicard	Patricksville, Stan. Co.	155,347	20,197 07	13.	38	J. Messerer.	Top gravel.
Delaney	" "					J. L. Jernegan.	
Chesnau	" "	27,250	11,089 00	40.4	18	A. J. Bowie, Jr.	
"	" "	71,810	9,847 48	13.	55	J. Messerer.	
"	" "	284,932	47,781 73	16.	12–62	"	Aggregate of 7 surveys checked by 2 surveys, June, 1874, to October, 1876.
"	" "	318,880	62,980 37	18.6	60	A. J. Bowie, Jr.	Includes the last.
New Light	" "	667,347	45,511 81	6.8	35	"	Drifted previously in places.
"	" "	683,244	45,444 65	6.6	24–60	J. Messerer.	Aggregate of 5 surveys checked by 2 surveys.
Johnson	" "	196,632	9,148 27	4.6	36	A. J. Bowie, Jr.	
New	" "	17,796	773 72	4.3	42	"	
Kelley	La Grange, "	88,660	3,406 33	4.	85	"	Result obtained from cleaning out a deep hole.
"	" "	353,159	43,153 26	12.3	75	"	
"	" "	701,685	15,770 34	2.2	100	"	Previously drifted. Heavy blasting. No profit.
New Kelley	" "	161,012	8,852 71	5.5	40	J. L. Jernegan.	Upper bench gravel.
"	" "	252,614	35,012 33	13.8	65	"	Top and bottom gravel.
"	" "	1,000,000	64,550 27	6.4	40–65	"	Includes the two last data.
French Hill	" "	252,614	35,136 72	13.8	45	"	Winter of 1876–77.
"	" "	676,968	90,186 19	13.3	10–48 (average 30)	J. Messerer.	Aggregate of 5 surveys checked by 2 surveys, May, 1874, to October, 1876.
"	" "	1,000,347	188,433 11	15.5	30	A. J. Bowie, Jr	Includes the last and also early workings, of which portions had been previously drifted.
Light	" "	746,640	64,714 27	8.6	48	"	Banks contained several thick strata of sand.
Blue Point	Smartsville, Yuba Co.	93,044	115,728 17	123.	57	H. Smith, Jr.	
Green Flat	Plumas Co.	22,000	15,000 00	67.5	15	A. J. Bowie, Jr.	
Fale's Hill	"	25,000	4,794 49	19.	75	"	
Crawford's	El Dorado Co.	77,880	35,046 00	45.	85	J. J. Crawford.	
Gold-Run District.	Placer Co.	43,000,000	2,074,356 00	4.8	?	W. H. Pettee.	

Water was drawn from the reservoir by means of a rocklined culvert placed near the bottom of the dam. In addition, three wrought iron pipes, each 18 inches in diameter, passed through the water-face of the structure. Each contained a gate (valve) to regulate the flow of water. When all three were opened, a flow of 280 cubic feet per second discharged into a covered timber sluice and thence on to the solid rock of the creek bed below the dam.

Vast quantities of water were stored behind Bowman Dam and similar structures scattered throughout the Sierra. Extensive ditch systems led downward from these to the hydraulic mines, in many places giving way to flumes and large diameter iron pipe which vaulted canyons and clung to the cliffs. By 1879, in Nevada County alone, nine water companies owned some 900 miles of ditches, with smaller ditches pushing the total to about 1,000 miles. All this was done at a cost of seven million dollars. Eight years earlier, in 1871, the California Water Company was organized in San Francisco and capitalized at $10,000,000 to operate a vast system in El Dorado County that consisted of two dozen lakes and hundreds of miles of ditches, flumes and pipes. The point is, large corporations, both foreign and domestic, were pouring millions of dollars into mining ventures throughout the Mother Lode region, and while other parts of the nation and the State were often suffering financial setbacks during the 1860s and 1870s, the Sierra mining belt was enjoying a prosperity it hadn't known for years.

Chapter III

The Debris Problem

From its humble beginnings in the early 1850s, the hydraulic mining industry grew to gigantic proportions. Moreover, it carried on its operations without a thought to the ultimate disposition of the mountains of waste material created — just as long as the waste didn't get in the way of gold recovery efforts.

For many years mining was the most important industry west of the Rocky Mountains. More than that, it was the first major industrial-corporate enterprise to be established in the hinterland of California. It can even be argued that the mining industry was the major factor leading to statehood in 1850.

There was, to be sure, some speculation as early as 1856 about the effect the mining debris was having, and might ultimately have, upon the rivers. But during the late 1850s the mines fell upon hard times, due in large measure to the exhaustion of the early placers and the technological barriers reached in hydraulicking. Besides this, the debris was for the most part wedged in the small mountain stream beds and narrow canyons near where it had been mined.

The first portent of the devastation that was to come was revealed in 1862 when torrential rains of unprecedented magnitude fell upon the state. Tailings of the 1850s were washed from their high perches and descended upon the valley. As the nasty conglomeration of mud, sand and gravel swept over unprotected farmsteads, the settlers raised their voices in protest.

The flooding, however, was so severe and general in nature, and the problems resulting therefrom of such proportions, that the cries of a few farmers went unheeded. The rains transformed the Sacramento and San Joaquin Valleys into an inland sea, 250 to 300 miles long and 20 to 60 miles wide. Rivers everywhere overflowed their banks, spreading ruin, devastation, and sometimes death, over wide areas. The dry creeks and arroyos became raging watercourses which converted the lowlands into shoreless lakes. Until the flood waters subsided, transportation, business and farming were at a standstill. Thousands of head of livestock perished, and possibly a fourth of the state's taxable wealth was destroyed.

When things dried up they really dried up. During the period 1862-1864 the "Great Drought" visited the state. Rich grasslands reverted to desert while the earth became like iron. The cattle and other livestock not taken by the floods died for lack of water and grass. Farmers and ranchers by the score were forced to abandon their holdings. In the mountains the mines had to be shut down for the lack of water required to work them. This in turn meant that little if any debris was being washed out of the mountains. Agrarian protest relative to the hydraulickers subsided in direct proportion to the lowering water tables.

With the mining boom of the late 1860s and 1870s however, hydraulicking was carried forth to unprecedented levels. Debris that was once washed into the small mountain streams was now being discharged directly into major tributaries of navigable rivers via the huge tunnels and extensive sluices. By 1868 the beds of the Feather and Yuba Rivers, where they meet at Marysville, were higher than the streets of the town. Meanwhile, the bed of the American River, where it joins the Sacramento, rose ten feet.

Whenever farmers congregated the conversation almost certainly turned to the problems caused by the ever-increasing amount of debris that was filling the rivers, causing floods and ruining their lands and crops. And to whom could they complain? During this period of history there was no governmental agency charged with controlling floods or guiding river reclamation. River management was the realm of private enterprise.

A cruel paradox existed for many of the valley communities and farmers. In large measure they owed their prosperity to the very mines that were the cause of their grief.* The sheet iron, nails, bolts, and manufactured goods used by the miners were either the products of the valley towns or were transshipped through them. In like manner the wheat, potatoes and other foodstuffs consumed in the mining communities were grown and sold by valley farmers. Closing or curtailing the mines would be a blessing on the one hand and a curse on the other.

There was as well the very real question of "right" involved. The hydraulickers began plying their trade prior to the development of the farmlands. Moreover, the capitalistic system was, and is, based on the principle of free enterprise. So, if the farmers were so unwise as to settle on land next to the rivers, with the knowledge that hydraulic mining was under way, whom should they blame but themselves? This line of reasoning is not unlike present day complaints levied by home owners who despair of the noise of aircraft after they build their houses close by a commercial airport.

In the case with the farmers, however, there was an additional factor. How were they to tell who originally held title to the mud that killed their orchards or buried their wheat crops? What individual or corporation was specifically responsible for the shoaling that was taking place in the rivers and bays? Who could be charged for the flood damages which resulted from the debris filling the channels near their homes and businesses? For years the farmers simply complained to one another while the townspeople (beginning in 1868) built levees to protect their interests.

The first really concerted action attempted by the farmers against the miners took place in Butte County during 1873. Egbert Judson and his associates gained control of the claims near the settlement of Cherokee and then proceeded to invest hundreds of thousands of dollars to develop the property. Hundreds of miles of ditches were built to bring vast amounts of water to a mining area which historically had been one of the driest. Soon round-the-clock operations were moving debris down Dry Creek and on to the farmlands below. Finally the farmers took action and filed suit against the Spring Valley mine. They asked for $2,000 in damages, and more importantly, for an injunction that would force the company to cease operating.

In deliberating the case the jury found that some 50 companies had over the years worked various gravels that were now resting on the farmers' fields and orchards. It was decided that damages might never be accurately assessed, and an order to stop mining would not remove the debris already spread along the Dry Creek valley, nor halt the damages within the foreseeable future. Other mines would continue operations, so turning off only a few of the monitors would not solve the problem.

*Richard Hoskins, inventor of the "Dictator" and the "Little Giant," had a factory in Marysville.

Another argument put forth demonstrated that the Spring Valley operation was worth hundreds of thousands of dollars, while the farms — individually at least — were worth relatively little by comparison. It was pointed out that a single day's production was more valuable than any farm damaged by the debris. Finally, it was reasoned that mining was the older interest, having begun in the Oroville, Butte County, region as early as 1853, years before the downstream lands were turned with a plow. In the end the jury found in favor of the hydraulickers.

A unique solution was found to solve the Spring Valley dispute. When the farmers gathered in the little community of Biggs during January of 1874, they served notice upon the miners that they were about to launch a sustained drive to put the hydraulickers out of business. Calling themselves the Hamilton Township Reclamation Company, they stated flatly that the Spring Valley Mining Company ". . . have impoverished the weak . . . and, judging by the past, they are inclined to continue by the use of might." (Sacramento *Record-Union*, January 12, 1874). This they would not tolerate any longer, and planned to knock the underpinnings from under the powerful hydraulic structure.

Judson and company reacted by buying up all the lands damaged by the mining debris. Then, showing rare foresight, they constructed levees some 10 to 12 feet high on the sides of Dry Creek. These levees extended from the foothills practically all the way to Butte Basin, a distance of 10 to 12 miles. There they built a settling basin by enclosing a large tract with a double ring of levees. Before they closed down operations in 1887, the company had purchased 21,000 acres of land for dumping and storing hydraulic mining debris.

Others, both farmers and miners, took note of the Butte County solution. Unfortunately, the debris problems along the Yuba, Feather, Bear and American Rivers were more complex, and thus didn't lend themselves to easy solutions. During the Spring of 1874 an article in the *Sutter Banner* pointed out that the ". . . amount of dirt brought down by the mining streams and deposited in the valley is . . . alarming. The bed of the Yuba at Marysville is already some sixteen feet higher than it was 20 years ago! . . . the worst is yet to come. In less than two years the amount of washings will be double what it is now. It is a saying among some of the miners that they are going to cover Marysville up . . ." (*Sutter Banner*, quoted in the *Mining and Scientific Press*, April 4, 1874.)

During the next several months various farm groups tried to organize their fellows, but to little avail. For the most part they just continued to grumble, issue oaths against the hydraulickers and sell them food and equipment. Perhaps if one ignored the problem long enough it would go away.

During the winter of 1875 a disaster struck the region that forced all concerned to deal with the issue. In January of that year steady rains and melting snow saturated the landscape. Finally, on January 19th, the Yuba overtopped the levees at Marysville, sending a torrent of murky water into the town. In the resultant panic people ran to safety as their homes and outbuildings floated off their foundations. Tragically, a little boy never made it to high ground and was drowned.

Within 24 hours the surrounding levees had created a lake, filled to the brim with muddy water and floating islands that were once stately homes and businesses. The full impact of the disaster wasn't fully appreciated, however, until the cold water began to drain away. As it did the stricken residents beheld an unearthly sight. Their once beautiful hamlet had been transformed into a vast dump for mining debris. For when the levees gave way, enormous quantities of mud and sand settled out of the flood and filled streets, homes and stores with muck several feet deep. Week upon week of discouraging toil was expended before the situation was righted. The flood of '62 had been bad, but the flood of '75 was catastrophic.

Three days after the levees broke farmers and miners alike read the reflections of L.S. Calkins, editor of the Nevada City *Transcript* as he summed up the dilemma.

> What are the owners of farms to do? It is an industry the whole world desires to foster. The Government will encourage it, notwithstanding agriculture may suffer. Hydraulic mining is in its infancy. The very storms which are so destructive to the valleys are just what the mines require. The sediment, which has been accumulated for years in the ravines and river beds, and preventing a good fall, has all been washed away, and made a place for the deposit of other quantities unwashed . . . Each year adds to the amount of sediment deposited in the valleys . . . It is evident mining will have to be stopped or that country will have to be abandoned for its present purposes, unless some method can be devised to overcome the difficulty. It is certain mining will never be stopped . . . What relief can be afforded we cannot apprehend.
>
> Nevada City *Transcript*, January 22, 1875)

The next winter was practically a repeat of the one just past. By this time, though, Marysville had built its levees higher, and it was now the turn of other valley towns, including Sacramento, to share the joys of floods, courtesy of hydraulic debris. Up and down the great valley editors of farm-oriented newspapers took up the banner of their comrades. While some questioned the right of the few to destroy the property of the many, others suggested that the state should buy up the gravel deposits and shut down the mines. Still others cautioned against trying to solve their problems through litigation, because they believed the courts to be slow in acting and expensive to use. For these the most prudent course was direct petition to the legislature.

By this time the farmers were joined by navigation interests. Travel on the Feather River had virtually ceased, and that on the Sacramento was severely restricted. As a result trade and commerce dependent upon the rivers were being curtailed. But even as the valley interests suffered, general agreement could not be reached regarding a solution. Many, in fact, felt it would be unfair to shut the mines down completely. This was brought out in January 1876 by the Sacramento *Record-Union*.

> It was long since pointed out by this journal that if no remedial measures were taken a time must arrive when the Sacramento River would cease to be navigable, and when the mass of detritus washed down would so fill its bed that it would spread over the adjoining country, resolve itself into a number of insignificant streams, and convert a vast fertile area into quagmire and morass.
>
> (The) main desideratum is to prevent

the mining debris from being washed down into the valleys . . . Of course there can be no question of stopping the development of the mines, but there is a strong question of the right of miners to destroy the valley lands in the way now proceeding . . . The city of Sacramento is deeply involved for disaster awaits her commerce and her safety.

(Sacramento *Record-Union*, December 24, 1875)

While some vacillated, there was a growing hard core group that wanted to crush the hydraulic industry. To this end they prepared petitions and sent them to the legislature. They also wanted the legislature to send a resolution to Congress condemning hydraulic mining. They wanted Congress to stop any new mines from opening until the existing operations took measures to impound their debris. Finally they would ask that a team of federal engineers be sent to California to research the matter and propose remedial action to Congress.

Unfortunately for the valley interests this was a time in which the legislature was being deluged with all sorts of resolutions, bills, proposals and petitions — all designed to limit the powers of the railroads, land monopolies, and corporations. Still others addressed the critical issues of public education, transportation and political corruption. In the end, those aimed at the hydraulickers got buried and, for the moment at least, forgotten. In large measure this was the same thing that happened to initial attempts at legislation drafted to limit or stop the miners.

Even so, enough pressure was being applied that mounting concern on the part of the miners, especially the large companies and their financial backers, caused them to meet in San Francisco during 1876 and form the Hydraulic Miners Association. The express goal of the organization was to fight any and all legislative attempts to slow or halt their operations. Moreover, the Association would defend in court all mine owners and water companies charged with illegal acts.

It is probable that the single act that pushed them to organize was a suit filed in July 1876 by James Keyes in the Tenth District Court in Yuba City. Keyes, representing the farmers of the Bear River region, initiated a suit in equity against the Little York Gold and Water Company and eighteen other mining, water and ditch companies and individuals operating in the Bear River basin. Keyes and his fellow farmers sought a perpetual injunction which would restrain the miners from depositing tailing in the Bear River and streams tributary to it. In addition, they wanted $10,000 for damages done to the Keyes farm by mining debris.

This first real test of strength dragged on for two years before it was finally decided. The initial phase was won by the miners who secured a change of venue to the federal courts. The second round went to the farmers in March 1879 when the decision was handed down awarding Keyes the cost of his suit (damages being impossible to fix) and a permanent injunction that would prevent the miners from discharging their debris into the Bear River or any of its tributaries. The third and final round was won by the miners when, upon appeal, the State Supreme Court (the case being sent back to the state from the federal court) invalidated the injunction on the basis of misjoinder of parties.

> If any one of the defendants is not liable to be enjoined in a separate suit, he can not be made liable in an action like the present, for there is no principle of equity which would make a man responsible for a wrong which he has neither done nor threatened, merely by joining him with other defendants who may independently have threatened a similar wrong.
> (Quoted in the *Mining and Scientific Press*, November 22, 1879)

Just as suits and threats of legal action caused the miners to organize, the slow progress of the courts regarding the Keyes suit was the principal force behind the valley interests to come together. Late in August of 1878, a group of farmers, businessmen, and townspeople met in Yuba City to form "The Anti-Debris Association of the Sacramento Valley." The stated objective of the Association was to prosecute to a final decision a case which tested the right of the miners to use the rivers as hydraulic dumps.

It must be noted at this point that while the center of attention was being focused upon the region of the Feather, Yuba and Bear Rivers, large hydraulic mining operations were not confined entirely to these watersheds. Hydraulic mining in the Sierra Nevada actually extended from the Butte Creek watershed on the north to below the Tuolumne watershed on the south. On the other hand it cannot be ignored that two-thirds of the hydraulicking done in the Sierra involved the Feather, Yuba and Bear Rivers. By far the greatest activity relative to this area was on the watershed of the Yuba. North Bloomfield, Moore's Flat, North Columbia, Red Dog, North San Juan, Omega, American Hill, French Corral, Sicard Flat, Smartville, Timbuctoo, and Mooney's Flat were some of the larger operations on that stream's watershed. Between 1849 and 1909, nearly 44% of the total of some 1,555,000,000 cubic yards of gold-bearing material mined by the hydraulic method was washed into the Yuba River. The following table reflects the amount of material mined on the Yuba and the other important streams during this same period.

Upper Feather River	100 million cubic yards
Yuba River	685 million cubic yards
Bear River	255 million cubic yards
American River	255 million cubic yards
Mokelumne-Tuolumne Area	230 million cubic yards
Lateral to Sacramento River (Butte Creek-Cherokee Canal)	30 million cubic yards
TOTAL	1,555 million cubic yards

In addition to the quantities in the above table, some mining debris entered the Sacramento River from Cottonwood and Clear Creeks, tributaries of the Sacramento flowing from the Coast Range. The hydraulicking on these two streams was done in the vicinity of Ono, Chicabally and Whiskeytown, but the quantity of debris from that mining coming to the Sacramento River was relatively small and the damage done negligible.*

* A great deal of hydraulicking was done on the Trinity River, principally in the vicinity of Weaverville. The La Grange Mine, located some three miles west of Weaverville, was at one time thought to be the largest hydraulic operation on earth. The debris from the La Grange Mine washed into the Trinity River, which flowed west directly into the Pacific Ocean, and thus never became an issue with the California Debris Commission.

From the late 1870s on, the sides were clearly drawn, and both endeavored to gain the ear of the legislature. On February 4, 1880, the assemblyman from Yuba County, J.P. Brown, introduced a bill drafted by the farmers entitled "An Act to Promote Drainage." The proposed law aimed at bringing into being an integrated system of levees and dams to restrain the debris and to develop means by which swamplands could be reclaimed. It is significant to note that the bill included language that specified the U.S. Army Corps of Engineers would be consulted relative to any and all plans. After weeks of bitter debate, the bill was passed in April 1880. This was truly a signal piece of legislation in that it created the first governmental agency, at the state level, to control rivers in the interest of the general populace.

Only two months later, the United States Congress directed the Secretary of War to make an examination of the navigable waters of California with a view toward preventing further injury to them due to mining debris. This directive was actually a follow-up to an earlier report made by Major George H. Mendell* of the Corps of Engineers in 1875, and to an evaluation completed by State Engineer William H. Hall in January 1880.

Within little more than a year, selfish interests tied to labor disputes and political rivalries forced the Drainage Act into the hands of the State Supreme Court where, in September 1881, the Act was declared invalid. The Court reasoned that it contained more than one subject and the subjects were not included in the title as required by the Constitution. Expanding upon this point, the Court maintained that debris storage was an entirely separate issue from that of improving drainage (contrary to the best engineering opinions). The Court went on to state that: (1) storage of debris was a private matter, (2) the legislature did not have the power to tax everyone for the benefit of a few, (3) the legislature had no power to establish duplicate and triplicate taxation, and (4) it had not the power to delegate legislative authority to an independent commission. In a single stroke the State Supreme Court destroyed California's ability to deal effectively with a regional problem. Thus, as it would eventually come to pass, federal intervention was not thrust upon California, but was forced upon the national government by a frustrated citizenry whose state leadership proved unequal to the task.

The Mendell report of 1875 reviewed the conditions of the Sacramento and Feather Rivers for the purpose of suggesting ways to improve navigation. A brief excerpt from this report will illustrate the general condition of the rivers at that time.

> The present physical condition of the river (Feather) is something wonderful, when we know that in 1849 it was the counterpart of the present Sacramento in all respects, namely, a succession of deep pools, separated from each other by shallow bars the water being remarkably clear. At the present day all the pools along the Feather River have been filled up with washings from hydraulic mines, and changed into broad flats, covered with a sheet of water densely charged with sediment, and often barely 2 feet in depth, the only deep water being where the channel is contracted to 300 feet and less. An idea of the extent to which this filling has taken place can be appreciated when I state that the bottom of the river today is on a level with the tule-lands inclosed by the levees. These same pools in 1849 contained fully 30 feet of water where now there is scant 2 feet, and the bars have also been covered with sand so as no longer to be seen.
>
> *(Annual Report Upon The Improvements of Rivers and Harbors in California — 1875 — Appendix EE5)*

The report concluded with the suggestion that brush wingdams be strategically placed within the river(s) to concentrate their flows, thus providing scouring action that would tend to deepen them. This, combined with snag removal, would greatly improve the navigability of the rivers.

The State Engineer's report of January 1880 painted a dark and sobering picture of conditions upstream from the devastation just described. Surveying parties described how the drainage systems of the American, Yuba, Bear and Feather Rivers were choked with sand, mud and gravel. The scene was one of devastation and ruin where enormous quantities of debris were stored in the higher reaches waiting only for winter storms to wash them out and on to the valley floor.

All of this of course supported the farming and navigation interests' contention that the hydraulickers were spreading ruin over the valley and its streams. Armed with these official findings, they once again laid siege to the mining strongholds. Late in July 1881, Judge Denson of Sacramento County, at the request of the State Attorney General, issued a temporary restraining order upon the Gold Run Ditch and Gravel Mining Company. On July 30, 1881, Sacramento County's Sheriff Ashley presented the operators of the Gold Run mine with the injunction. Three and a half months later the case of the People v. the Gold Run Ditch and Mining Company went to court. The litigation, which dragged on for seven months, came to be recognized as the most significant debris suit brought to that time. Expert opinion was secured from every quarter. Almost daily, prominent engineers and other authorities shared opinions in support of one side or the other.

> Its importance . . . rises to the highest plane, because it has brought to its management some of the best minds at the bar of California and an ex-justice of Supreme Bench, beside other attorneys of broad experience and high character at the bar. The judge presiding is himself an ex-justice of the Supreme Court.
>
> As to the developments in the case, it is to be noted that no trial in California has ever brought forward such an array of talented engineers, chemists, physicians, and gentlemen of high scientific attainments, have occupied the witness stand day after day. . . This case has brought forward some of the most skilled agriculturists of the state. . .
>
> (*Sacramento Daily Record-Union*, November 19, 1881)

Following two months of intense and often conflicting testimony, formal arguments opened in the Supreme Court Room of the Capitol. These were completed within a few days, and the case then rested with Judge Jackson Temple.

While the judge was pondering the

* The inspection of the rivers and the drafting of the report was actually done by L.J. LeConte and his assistant, J. Geraghty, under orders from Mendell.

evidence, Lieutenant Colonel Mendell of the Corps of Engineers had completed his second investigation of the debris problem (ordered by Congress in June 1880). Mendell, with the assistance of Lieutenant A.H. Payson, carried out an incredibly extensive survey of the mining debris problem throughout the entire mining region. For the first time reliable data were collected relative to the effect mining debris was having upon both the Sacramento and San Joaquin Rivers and their major tributaries.

Mendell recommended that, in addition to the brush dams constructed by the state under the Drainage Act in the channels of the Bear and Yuba Rivers, truly substantial stone barriers should be put up on all the major rivers draining the mining region. The primary mission of these new stone dams would be to restrain hydraulic mining debris. In addition, it was Mendell's view that they, along with brush wing dams, would improve navigation upon the rivers and enhance their flood-carrying capacities. All of this then would afford the farmers the protection they desired, while allowing the miners to continue to operate.

For their part the farmers became enraged at Mendell and his plans. They felt that building debris dams would only encourage the hydraulickers to expand their operation and influence the courts to lift their injunctions. Some farming interests went so far as to condemn Mendell and the Corps of Engineers as being pawns of the miners. The farmers wanted the evil giant — hydraulic mining — crushed; nothing less would do. Once this had been accomplished, dams could be built to stop the movement of existing debris, and attention could be focused upon river reclamation.

All the while, Judge Jackson Temple had been considering the merits of the arguments put forth during the Gold Run suit. On June 12, 1882, he rendered his decision. The essential elements of the decision were: (1) miners had never acquired the right to use the rivers as dumps; (2) hydraulic mining constituted a public nuisance in that it prevented free use of riparian lands and free navigation; (3) a perpetual injunction was issued which prohibited the Gold Run mine from discharging "coarse" debris into the North Fork of the American River or its tributaries; (4) the company could build restraining works (debris dams) and have the injunction lifted if the Court could be convinced that the works would store the "coarse" debris at or near the mine, and not let it move onto the valley via the river.

Temple felt that if the miners were forced to impound all of the debris, they could not continue operations. So, in effect, he left a way for them to continue while still providing a measure of protection for the farmers. He stated that, "Perhaps I am somewhat moved to this by the consideration that otherwise mining can never be prosecuted at all. . . I confess I shrink from a consequence so far-reaching." (*Sacramento Daily Record-Union*, June 14, 1882; also The People v. The Gold Run Ditch and Mining Company, 66 Calif., 138)

Upon learning of the decision, valley interests were delighted, while foreboding and despair settled over the mountains. Both reactions were premature. On the one hand the farmers had achieved only partial victory, while on the other the miners only had to suffer the inconvenience of building debris dams before they could continue.

Some of the largest mining corporations saw the turn of events as an opportunity to snatch up all of the mines in the region. They proposed that an organization be formed to control both mining and water supply/distribution throughout the western Sierra. The association would also try to gain control of all the water rights in the watershed, build massive dams to restrain all debris, and purchase acreage in the valley for mining dumps. If they could pull it off, a single, giant organization, controlled by a handful of powerful men, would exercise effective control of every mine in the area. This scheme to reign supreme over the richest Tertiary gravels in the state came to naught when several of the smaller mining companies failed to see the benefits in such a plan.

Realizing that they had but won a battle and not the war, the farmers continued in their efforts to shut down the hydraulickers. Late in the summer of 1882 the Board of Supervisors of Sutter County initiated suits against every hydraulic mine on the Bear River. Several of the larger mines on the Yuba were also served with injunctions. Sacramento County joined the siege by bringing suit against the New Gold Run Mine, located on the North Fork of the American River. The farmers' attack was relentless.

Stone Dam, the type that Mendell felt could restrain mining debris. (Corps of Engineers' photo)

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This advertisement shows that the Hendy Machine Works began operations during the period of controversy over hydraulic mining.

Early in the fall of 1882, Edward Woodruff, a citizen of New York State who owned property in and around Marysville, entered the Ninth United States Circuit Court in San Francisco and filed a suit that would mean the end of hydraulicking. His suit asked for a perpetual injunction against the North Bloomfield and all other mines on the Yuba River. Within a few days Judge Lorenzo Sawyer notified the defendants that they must show why a temporary injunction should not be issued (closing the mines) while the suit was being heard. The case proved to be as noteworthy as the earlier Gold Run litigation and, like it, caught the attention of the press and the general public. Similarly, the suit extended over some eighteen months before the initial decision was made.

Lorenzo Sawyer played a critical role in the economic history of California during this period; thus, a brief biographical sketch is in order. He was born on a farm in Illinois, learned quickly, studied law, and was one of the first to come overland in the Gold Rush of 1849. Sawyer staked a claim in the Nevada City area and worked as a miner long enough to come to the realization that he would rather make his mark with his head than with his hands. He opened a law practice later in Sacramento, plied his trade in Nevada City and finally in San Francisco. In 1862 Governor Leland Stanford appointed him a district judge in San Francisco. Eventually, he was elevated to the highest federal position in California, the circuit judgeship in San Francisco. Over the years he reportedly became a close friend of Stanford and other railroad and corporate interests. Some even hold that his decision in the North Bloomfield case was based upon the relationship that he had with Stanford and company.

In the final analysis, however, there exists practically no real evidence to support such an allegation. His general reputation suggests that he was an honest, reflective, and conscientious jurist. The miners certainly saw him in that light, and were, in the main, quite content to have him decide their fate. According to the editor of the Nevada City Daily *Transcript*, of September 24, 1882, "He is one of the most distinguished jurists in the State, and the miners are well satisfied to rest their case in his hands. . ."

During the course of the North Bloomfield suit, Sawyer made several visits to

Log dam failure, Volcano Canyon near Foresthill

the farms and miners involved in the case. In addition to the firsthand view of the devastation caused by the "giants" and "monitors," he saw that the primitive debris dams — many but a year old — were already filled and often buried. In other cases, substantial timber dams, such as the one built on Humbug Creek to restrain the debris from the North Bloomfield mine, had burst and were therefore useless.

While on his last trip to the mining region in October 1882, he paid particular attention to the Yuba River basin. Here he discovered that all the debris dams were either filled to capacity or broken. Even the large Smartville structure, located above Marysville, was totally covered with debris. In like fashion, the brush dam built by the state across the Yuba River was hardly visible.

Judge Sawyer decided the first part of the suit during April 1883, in favor of the farmers. Since the time of the Keyes case, the miners had argued that such suits were invalid on the ground that they constituted a misjoinder of parties. Sawyer set this aside once and for all when he wrote:

> After careful examination and analysis of the numerous authorities . . . I am entirely satisfied . . . that there is no misjoinder of defendants . . . They all pour their mining debris into several streams, which they know must, by the force of currents, be carried down into the main river, where they commingle into an indistinguishable mass long before they reach the point where the nuisances complained of are committed and damages are created . . . Defendants claim a common, though not joint, right . . . The final injury is a single one . . . and all defendants cooperate in fact in producing it.
>
> (Decision quoted in the Sacramento *Record-Union*, April 10, 1883)

In the meantime, Congress had acted upon Lieutenant Colonel Mendell's, and the Corps of Engineers', suggestion to build one or more huge dams to restrain the debris, and appropriated $250,000 to this end. Upon learning of this the farmers became furious, re-stating the old argument that large government dams would only encourage the industry at a time when complete victory appeared within their grasp. Responding to their heated petitions, Secretary of War Robert Lincoln

(Abraham Lincoln's son) sent his personal representative, Colonel John M. Wilson*, to the Sacramento Valley during the summer of 1883 to size up the situation so he might be advised as to the most prudent course to follow.

Colonel Wilson quickly learned of the farmers' uniform hatred of the Corps of Engineers' plan to construct large dams and so advised Lincoln. The latter wasted little time in reassuring the farmers that none of the money appropriated would be spent until further study was done and it was determined that such dams would best serve the public interests.

All the while, the landmark North Bloomfield case continued. Special commissioners were appointed to hear testimony. By the time they completed their work, more than 2000 witnesses had shared their opinions about the situation, and some 20,000 pages of testimony were recorded.

From his courtroom in San Francisco, Judge Sawyer issued his final decision in the case on January 7, 1884. He began reading the verdict at 11:00 a.m. and didn't finish until 2:30 p.m. The 225-page decision described in considerable detail how the debris from the mines had substantially injured the welfare of the valley and its residents. Once again it was pointed out that even the state-built dams, constructed at a cost of half a million dollars, were absolutely useless in the face of the glacier of debris coming out of the mountains. In a similar manner, the privately-built debris dams had filled with gravel, burst, and thus were of no use. As he approached the end of his reading, Sawyer stated that the defendants were perpetually enjoined from discharging tailing of any size or type into the Yuba River or any of its tributaries. His decision positively forbade the dumping of debris into the streams. Moreover, the mine owners were prohibited from allowing anyone else to exploit their facilities to mine by the hydraulic method. Every legal loophole was effectively closed.

Judge Sawyer's ruling meant the virtual end of hydraulicking, but the coup de grace was delivered by the State Supreme Court in November 1884 when it upheld the major portion of the Gold Run decision but overturned that section which had allowed mining to continue if only the "coarse" material was restrained. The high court held that hydraulic mining constituted a general nuisance, and that no person or corporation had the right to blanket another's land with "slickens," as the debris was often called.

Within a few months of the "Sawyer Decision" the mining region was gripped by economic as well as moral depression. Not only did the mining industry suffer, but auxiliary and support industries and services as well were hard hit. From Dutch Flat to Red Dog unemployed miners walked aimlessly about muddy streets muttering to hotel owners and shopkeepers whose consternation matched their own. Businesses closed, the pack trains stopped coming and the sawmills laid off their workers and shut down. Officials in the mining counties paged through their assessment rolls, reducing the valuation of mines and ditches to a fraction of their previouis values. During the first year after the decision, it was estimated that gold production dropped $3,000,000. On the other hand, while many left the mining belt region, many others stayed — refusing to believe that a once thriving and powerful industry, involving 500 mines and more than $100,000,000 in value, could be halted by mere words set down on paper.

Even before the decision was rendered, engineers and others trained in hydraulic mining felt certain the final blow was about to be delivered and left the state. Hamilton Smith, builder of the North Bloomfield, migrated to Venezuela. At about the same time, Gardner Williams of the great Spring Valley mine near Cherokee, Butte County, departed for South Africa, where he developed the great diamond fields for Cecil Rhodes. Much of the necessary talent needed to keep the great mines operating was being scattered to the major mining centers around the world.

While the large mines were easily located and monitored, it was relatively easy for individuals and small groups to carry on clandestine operations — where plentiful water was available. For several years after the Sawyer decision, "giants" and "monitors" could be heard — if not seen — tearing away at the mountains. The remaining miners seemed determined to risk substantial fines and possible imprisonment to carry on their chosen profession.

The Anti-Debris Association's rage swelled with every report of illegal hydraulicking. When they could tolerate it no longer, they sent "spies" into the mountains in search of the culprits. The farmers were absolutely determined to dry up every nozzle within the watershed. Their agents were spotted easily by friends of the mining interests, and treated rudely on every occasion.

In the valley the newspapers urged constant vigilance:

> It is now apparent as ever that the people of the Sacramento Valley must not slack an iota in vigilance and labor. . . Of late there has been a relaxation on the part of the valley people because of over-confidence. . . The inaction of the last six months has encouraged and emboldened the hydraulic miners. Already the moral as well as legal force of Judge Sawyer's decision is waning because of the laxity of officials and attorneys enforcing it.
>
> (*Marysville Appeal*, July 25, 1884)

This type of pressure resulted in further action, until even San Joaquin County filed suit against the limited operations sending debris down the San Joaquin River and those major streams tributary to it.

Since hydraulicking had been enjoined by the courts, navigation interests saw little value in waiting any longer to spend the money Congress had appropriated for river reclamation. It was critical that this work get under way because each year's rains brought higher floods and left the rivers ever more difficult to negotiate. With a view toward this end, the Sacramento and San Francisco Chambers of Commerce petitioned Congress to allow the appropriation already made to be spent on the high dams recommended by the Corps of Engineers some years earlier. Congressional committee hearings resulted in a proposal to appropriate a quarter of a million dollars for this work, provided that hydraulic mining had actually been halted. Almost immediately, the assemblyman from Amador County, Anthony Caminetti, persuaded the California legislature to pass a resolution certifying that all such mining had been arrested since Judge Sawyer handed down his decision.

Once again, however, the farmers

* Colonel Wilson later was elevated to Brigadier General and appointed Chief of Engineers.

descended upon the state lawmakers en masse and let Washington, as well, know of their extreme displeasure. Hydraulicking for them, while severely wounded, was not dead, and debris dams would only serve to heal the detested beast.

Over the next few months they continued the pressure at both the local and national levels. As a result Congress appropriated but $40,000 for river improvements on the Sacramento and the Feather. More than that, this modest sum could not be expended until the Secretary of War had been convinced that hydraulic mining on streams tributary to these rivers was indeed over and done with. This meant that no remedial measures — not even snagging — could be prosecuted by the Corps of Engineers until every last mine had been shut down.

The battle was no longer one between large corporations and the Anti-Debris Association, but had descended to the level of county governments engaged in a twilight struggle with many small companies and individuals hanging on by their fingertips and trying to dig out a living for themselves and their families.

Typical of this sort of thing was the suit filed by Sutter County against about forty small hydraulickers who had ignored the Sawyer decision and kept right on mining near the Feather River in the then remote Plumas County area. The miners in the region, particularly in the environs of Quincy and Meadow Valley, reacted rather violently, proceeded to form the Feather River Miners Association, and dared the farmers and their agents to try and stop them.

When a United States marshal appeared in Quincy (county seat of Plumas County) during the spring of 1887 to determine if the miners had obeyed the injunction of the previous year, he was met with contempt. Local residents suggested that his health would no doubt suffer if he didn't repair to the valley from whence he came. The proprietor of a lodging house confided to the marshal that if he were permitted to room there, the place would be burned to the ground. Some miners even suggested that tarring and feathering would be in order. When the lawman tried to secure a horse to visit the nearby mines, no animals were available. Finally, after reaching one of the mines, the marshal was greeted by the shotgun-carrying owner.

For awhile it seemed as though Plumas County was under siege. Strangers were looked upon with suspicion and treated harshly. Even so, valley agents continued to come to the mountains and serve their papers, and slowly the mines of Plumas County were closed to hydraulicking.

Brandy City Mine, Sierra County, showing three monitors in operation. (Corps of Engineers' photo)

While the small operators struggled as best they could in the back country, the Miners Association, and its president Lester Robinson, carried the fight back to the legislature. In 1885, he convinced Senator Cross of Nevada County to introduce a bill that would authorize private companies to build large debris dams. The effort came to nothing when valley interests rose to the challenge and were able to defeat the bill. Then in the spring of 1887, the miners again petitioned the state's lawmakers to sanction high dams. On this occasion, primarily because of the general economic condition of the country, the legislature was inclined to approve measures that would stimulate the economy. After days of intense debate, the hydraulickers were defeated by the narrowest of margins.

Even though they failed to gain legislative relief, the miners were joined by navigation and flood control interests. By the end of the legislative session of 1887 this combined force was able to secure passage of a memorial to Congress that sought a definitive federal investigation of both the debris problem and the possibility of river reclamation. In January of 1888, Congressman Marion Biggs from Gridley, Butte County, introduced a bill in Congress that encompassed both concepts. Again, as expected, the farmers were opposed to anything that smacked of debris and the mining that produced it. On the other hand, the miners, and to a limited extent navigation interests, strongly endorsed the measure and sent letters in support of the proposed law. Finally, in the fall of 1888 Congress passed the bill and appropriated $100,000 to provide for a commission of three Corps of Engineers officers to study the entire problem and, if possible, submit a plan whereby hydraulic mining could be resumed and river reclamation initiated.

The Corps of Engineers officers, known in this case as the Biggs Commission, held their first meeting in San Francisco in November 1888. During the next two years the officers traveled about the valley, inspected the rivers, talked with farmers, went into the mountains, visited the mines, and recorded voluminous testimony. In the meantime, the severe winter of 1889-90 brought rains that again put the

Even a century after it was closed, the huge Malakoff Mine at North Bloomfield still reflects the power of the monitors that once washed away the mountains. (Corps of Engineers' photo)

rivers over their banks, bringing home the desperate need to gain control of these vital watercourses. At the same time the Sacramento Board of Trade called for a convention to meet and draft a petition to Congress. In January 1890, representatives from the flooded areas sent a plea to Washington asking that money appropriated earlier, but held up due to the hydraulic controversy, be released to build levees along the Sacramento, Feather and San Joaquin Rivers. Shortly thereafter Congress made these funds available for federal flood control works on the Sacramento River.*

In February 1891, the Commission, consisting of Lieutenant Colonel W.H.H. Benyaurd, President; Major W.H. Heuer, member; and Major Thomas H. Handbury, member, made known its findings. Just as the three engineers became known as the Biggs Commission, the report they prepared has come down to the present as the "Heuer Report." The report was both lengthy and detailed. It was separated into major sections, such as hydraulic mining; gravel deposits; the various mining districts; condition of the farming lands; mining streams; mineral wealth remaining; conditions of the major rivers; lists of statistics, and a host of other topics. The report even included communications exchanged between the Corps of Engineers officers and the interested parties.

Heuer, in his concluding remarks, summed up the situation nicely, and suggested a definitive course of action.

> The duty devolving upon the Board is to ascertain if some plan can be devised whereby the present conflict between the mining and farming interests can be adjusted in order that the hydraulic mining industry can be again carried on without injury to the farming interests and the navigation of rivers.
>
> Hydraulic mining is now suppressed under the decision of the Federal courts. It is not apparent to the Board that any expresson of opinion or recommendation will have any effect in rehabilitating the industry in the present legal status of the question. Without some modification, then, of existing conditions hydraulic mining must cease. It can not be carried on without violating the decrees of the courts.
>
> If, however, by a reversal of the opinions of the courts or by other means, hydraulic mining be permitted in whole or in part, or if, without such reversal, an expression of opinion is required as to the feasibility of impounding debris, the Board will state that the investigations and examinatons made indicate that in isolated cases it is possible to impound debris without injury; also, that locations exist in the canons of the different mining streams in the Sierra district where permanent stone dams, properly constructed, will retain large quantities of material of the character formerly mined out and which caused the destruction of the farming lands and injured the navigation of the rivers.
>
> These dams, however, will not be effective in impounding all the material delivered into the canons from the mines. Being in the streams and in the pathway of the freshets, portions of the heavier material will be carried over the crests of the dams to eventually find lodgement in the river below. The finer sands and clays can not be effectually impounded by such barriers, but will be carried in suspension. With the improved condition which it is desired to give to the navigable rivers it is probable that the greater part of this finer material can be carried off without being productive of harm.
>
> The locations of the dams on the different mining streams are stated in the report.
>
> The construction of the dams being called for entirely in the interests of the miner, the cost thereof should be borne by the individual interested. . .
>
> The navigation of the rivers in the Sacramento Valley has been injured by the operations of hydraulic mining. The details of the condition of the Sacramento and Feather Rivers are set forth in the foregoing portion of the report. The injury has been caused by the deposition of vast quantities of mining debris in the beds. In addition there are vast deposits of material lying in the canons and in the

* The Corps of Engineers first began work on the Sacramento and Feather Rivers in 1875. This work consisted primarily of removing snags and building brush wing dams so as to improve navigation upon the rivers. Even though they recognized and studied the debris problem since 1875, they were not permitted to spend money specifically authorized for debris control until years later.

plains below the foothills, portions of which will be carried down during floods and eventually lodge in these streams. It is proposed to improve the rivers, first, by restraining the debris now lodged in the canons of the Yuba and Bear and in the plains below by dams and other restraining works; second, by contracting the widths of the rivers by brush wing-dams in their beds. The system of restraint will be continued until the rivers in their improved condition can carry the material brought down.

The estimated cost of this improvement is:

Feather River wing-dams	$300,000
Sacramento River wing-dams	$300,000
Dam on Yuba River at Daguerre Point	$640,000
Dam on Bar River at Van Giesen's	$150,000
Restriction works on Yuba below foothills	$300,000
Maintenance of navigation on the Feather while the above-proposed works are in the course of construction	$ 20,000

(*Report Of Board Of Engineers On Mining-Debris Question in State Of California* — printed in the Report of the Chief Of Engineers, U.S. Army, 1891, as Appendix VV, also printed in House Ex. Doc. No. 267, Fifty-first Congress, second session)

The Engineers' report brought renewed hope to the miners. They believed, or at least desperately wanted to believe, that full-scale revival of the industry was near at hand. The need to reorganize was obvious, so in January 1892, thirty-five counties sent representatives (including valley counties) to San Francisco to establish the California Miners Association. Under the leadership of J.A. Filcher, editor of the Dutch Flat *Placer Herald*, this new brotherhood of ordinary miners stated their opposition to illegal hydraulicking, while at the same time working vigorously for Congressional approval of the Biggs Commission recommendations. Shortly thereafter, the lawyer Anthony Caminetti, recently elected to Congress from Jackson in Amador County, introduced a bill that incorporated the major

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Committee on Legislation.

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Committee on Mineral Lands and Conservation of Water.

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Committee on Department of Mineral Industries.

Hon. W. C. Ralston, Frank Solinsky, Thomas Clark, J. W. Bartlett, Frank A. Leach, Niles Searls, H. H. Yard.

Committee on Debris Dams.

A. Caminetti, Fred. Searles, A. Baring Gould, William Nicholls, Jr. Fred. Harvey, Mark B. Kerr.

Committee on Election.

W. H. Storms, Harry East Miller, J. W. C. Maxwell, Nat. P. Brown, A. A. Tregidgo.

Officers and Committee Members of the California Miners' Association - 1904.

recommendations found in the Heuer Report. In addition, his proposed legislation would create the California Debris Commission and give it the authority to license hydraulic mining when and if it could be done in accordance with rules and regulations designed to safeguard farms and rivers. Late in July of 1892 Caminetti's bill sailed through the House and was approved by a large majority. By the time it got to the Senate, the session was about over and Congress adjourned before the upper house could act upon the bill.

Between legislative sessions the farmers organized once again to keep the nozzles shut off. A State Anti-Debris Association was quickly formed for the express purpose of defeating the bill should it be reintroduced. Unfortunately for the farmers it was the worst possible time to try to crush an idea which promised to bring new sources of employment and wealth to the state. For during the late 1880s and early 1890s the nation's economy was on a downward slide. Labor disputes became especially heated, and in more than one instance federal troops were called out to maintain order. The Populists and Socialists were putting forth ideas that seemed revolutionary at the time, and brought fear to the hearts of many traditional politicians.

In February 1893, the Philadelphia and Reading Railroad — one of the country's largest — fell into receivership, with debts of over $125,000,000. This as much as anything else was a preliminary view of the economic depression that was to come. In fact it would only be months before the issuance of gold certificates would be suspended by the U.S. Treasury because gold reserves had fallen below the legal minimum of $100,000,000. This was followed by the failure of the National Cordage Company in May 1893. At about the same time securities fell sharply on the New York Stock Exchange, and in June the market crashed. The nation plunged into extreme economic depression. During 1893, 600 banks closed, over 15,000 commercial houses failed, and 74 railroads (a third of the nation's) went into receivers' hands, including the Northern Pacific, Union Pacific, Erie, and the Atchison, Topeka and Santa Fe. History has recorded this time as the "Panic of 1893."

With this as the background then, it is not surprising that California's legislature adopted a joint resolution asking Congress to approve Caminetti's bill. Nor is it difficult to understand that Congress responded favorably to the petition. The President signed Mr. Caminetti's bill into law in March of 1893.

Chapter IV

Creation of the California Debris Commission

On May 3, 1893, President Grover Cleveland appointed Colonel G.H. Mendell, Lieutenant Colonel W.H.H. Benyaurd, and Major W.H. Heuer — all Corps of Engineers officers — as members of the California Debris Commission. Section 4 of the Act of March 1, 1893, which authorized the Commission, stated:

> That it shall be the duty of said commission to mature and adopt such . . . plans . . . as will improve the navigability of all the rivers comprising said systems, deepen their channels and protect their banks. Such plans shall be matured with a view of making the same effective as against the encroachment of and damage from debris resulting from mining operations, natural erosion, or other causes, with a view of restoring as near as practicable and the necessities of commerce and navigation demand, the navigability of said rivers (the Sacramento-San Joaquin, and all of their tributaries) to the condition existing in eighteen hundred and sixty, and permitting mining by the hydraulic process . . . to be carried on, provided the same can be accomplished without injury to the navigability of said rivers or the lands adjacent thereto.

In all, the organic act had twenty-five sections that detailed the duties and responsibilities of the Debris Commission. Besides their primary duties of protecting the rivers and supervising any and all hydraulic mining in the watershed of the Sacramento and San Joaquin Rivers, the Commission was authorized to carry out extensive research of the industry and, where possible and practicable, build large, high debris dams. In turn, the miners, who were permitted to mine and dump tailing into streams behind the debris barriers, would have to reimburse the government for this construction by paying a tax of three percent on the gross proceeds of their mines.

The Commission was an extremely powerful body, and, in cases dealing with hydraulic mining, it constituted judge, jury and executioner. It was the supreme authority in all matters relative to the subject. In addition, the three Corps of Engineers officers were empowered to establish their own operating procedures and to interpret them as they deemed appropriate. Finally, the Commission was "granted the right to use any of the public lands of the United States, or any rock, stone, timber trees, brush, or material thereon or therein, for any of the purposes of this act." . . .*

Few groups in history have been afforded such absolute authority over a private commercial sector of society as was given the California Debris Commission.

To take advantage of the new law, miners had to apply to the Commission for permission to operate. In almost every case this meant that a dam had to be constructed by the applicants at or near the claims. This in turn required that plans and specifications had to be drawn and submitted as well. Once received by the Commission the application would be advertised and a hearing held to listen to possible objections. If there were no significant objections to the application(s), the engineers would approve the plans so that the mine could be made ready to work, and the necessary restraining barriers built. Once all was completed, the Debris Commission would conduct an on-site inspection. When, and if, all was found to be in order, a license to mine by the hydraulic method was issued. That was not the end of the matter, however, because if at any time thereafter damage resulted to downstream areas, the license could be immediately revoked.

Though hailed as the remedy to miners' economic ills, the Caminetti Act proved to be far less than the hoped for signal to immediately open the mines and turn on the "giants." For besides the potential difficulty one might experience in securing a license, there remained the practical problems associated with hydraulicking.

During the long decade since the Sawyer decision had shut down the major operators, the terrible winters of the Sierra had taken a heavy toll on the equipment and water-delivery systems. With the financial backing of the San Francisco-based corporations a thing of the past, systems could not be replaced nor properly maintained. Small operators, which constituted the bulk of the miners, simply could not afford to repair the flumes, ditches, broken pipes, rotting trestles and rusting monitors. The once all-powerful industry, reduced as it was to but a shadow of its former self, seemed to be caught up in a vicious circle of circumstances. Because of the Sawyer and Gold Run decisions, the mining equipment was little used and seldom repaired. Add to this the savage winters, equipment deteriorated further and became ever more expensive to repair. Combined with legal problems, the poor equipment made it almost certain that there would be less and less income as one mining season followed another. The end result was little money to replace and repair the essential appliances of hydraulicking. By the end of the nineteenth century there was not a hydraulic pit in the Sierra capable of large-scale operations. Even so, the miners came forth and tried to rehabilitate the industry.

The Caminetti Act, reduced to its basic elements, was a piece of compromise legislation, encouraged by a state desperate for new revenues, and passed by a Congress frustrated with a nationwide economic depression. As in the case of any compromise, neither side was completely satisfied with the new law. The valley interests were satisfied to have the issue resting in the hands of a governmental agency, but were not convinced that small dams, built by the mine owners, would safeguard their fields and crops against the flood of new debris. Longtime opponent of hydraulicking and valley resident, George Ohleyer, wrote a letter to the editor of the San Francisco *Bulletin* stating:

> To the average valley mind it is becoming apparent that the rights of the sufferers are to be subverted and a conflict instituted that must end in disaster to all interests. For as certain as fate, on the heels of the monitor will come deserts in mountain and valley, and if anybody is to be enriched it will be at the foreign money centers.
>
> (Quoted in the Grass Valley *Daily Morning Union*, April 7, 1893)

As a precautionary measure, the Anti-Debris Association sent its agents into the mountains to remind the miners that they should proceed only in a lawful fashion, and not to get the idea that the Caminetti Act was carte blanche for renewed activity. In the main, however, the valley was willing to maintain a guarded "wait and see" attitude, trusting that the Debris Commission would protect their interests.

The miners found that the Act left much

* For a complete text of the Act of March 1, 1893, see Appendix A.

to be desired. For the time being, at least, they felt that it was better to have

> the bill in its present shape than to have no legislation at all, and to depend upon further amendments . . . as it is held that it will be better to trust to the decision and supervision of a board of scientific engineers than to endure the espionage of spies, fines and imprisonments with which the miners have been inflicted since the Sawyer decision, which has been prolific in creating trouble and engendering ill feeling between the mountain and valley people.
>
> (Grass Valley *Daily Union*, February 18, 1893)

The majority of the miners, happy on the one hand but suspicious on the other, were generally content to trust in the Debris Commission for their salvation. In fact, a growing sense of confidence was evident in many parts of the mining region as the old hydraulic pits became the scenes of renewed activity. To a limited degree, the investment community looked to the mountains once again and began securing options on abandoned claims. Moreover, several of the larger mines began conducting surveys for debris dams and preparing applications to be submitted to the Commission.

The California Debris Commission held its first formal meeting on June 8, 1893, in San Francisco, with Colonel George Mendell as president. The first application to mine under the Caminetti Act was made by R.M. Mooer, owner of the Kelly Hill mine located in Butte County, on August 2, 1893. The second to make application, but first to receive a license to mine, was the Farrel mine located in Nevada County and owned by the Eureka Lake and Yuba Canal Company. They simply built a 12-foot-high dam of logs and earth across the mouth of an old hydraulic pit and thus were ready to turn on the "giants."

During its initial year of operation the Commission received almost a hundred applications to mine by the hydraulic method. After reviewing the applications and making on-site inspections, the engineers granted permits to more than sixty of the petitioners. In some cases, however, the owners of the larger mines, who were opposed to the Commission from the beginning, wanted to continue as they always had. The huge North Bloomfield, for example, held the view that because it was operating with the consent of the court, it wasn't bound to make application to the Commission. The North Bloomfield had been utilizing a hydraulic elevator to move its debris to a settling basin, and continued to do so for more than a year after the Commission began operation.

In the summer of 1894, the Anti-Debris Association lodged a complaint with the engineers to test the validity of their respective positions. The Commission instructed the owners to cease operations and to make application according to adopted procedures. The mine owners ignored the order, whereupon the United State District Attorney, in June 1895, brought suit against the North Bloomfield seeking an injunction which would force the owners to comply. In March of 1896, Judge McKenna of the U.S. Circuit Court, ruled in favor of the government. His decision stated that hydraulic mining without a permit was illegal. Hence, if owners wanted to continue operations, no matter how large or small, they must first secure a license from the California Debris Commission.

The engineers took their charge seriously and revoked the licenses of mine owners who tried to subvert the intent and spirit of the Caminetti Act. On the other hand, the Commission felt that in many cases the miners were being unjustly chastised by the local courts. Colonel Heuer summed up the situation in his report to the Chief of Engineers in July 1904.

> As in previous years, it has been reported that injunctions were issued by county courts during the past year enjoining the operators of several mines holding permits from the Commission from operating by the hydraulic process. The proceedings in such cases as were brought to the attention of the Commission were instituted against the operators of the mines by or at the instance of the anti-debris association . . . It would appear that in some cases injunctions of the local courts against operators holding permits from the Commission encroached upon the act of Congress of March 1, 1893, inasmuch as the effect of that act is to authorize, subject to its several provisions, operators of hydraulic mines to work, when they have received permits to do so from the Commission, the issuance of such permits by the Commission being in itself evidence that the operator has complied with the law and provided a dam or other suitable means for properly impounding debris. Aside from defeating the object of the act of Congress of March 1, 1893, the intent of which is plainly to permit hydraulic mining under certain restrictions, and certainly not to sweepingly prohibit it, the injunctions issued by the local courts often work great hardship to the miner.
>
> (*Appendix ZZ Annual Report of the California Debris Commission for the Fiscal Year Ending June 30, 1904)*

The Debris Commission itself, for that matter, was not having all that easy a time. Late in the winter of 1895, the Commission requested an appropriation of $20,000 so that it could effectively carry out its dual roles as river protector and hydraulic rehabilitator. The request was denied. It seems that Congress approved of river control in principle, but was reluctant to actually deliver the funds necessary for implementation. Finally, in the spring of 1896, funds were made available for river work, but even this didn't clear the way for the Commission to get started. It seems that the State of California was required to pass legislation allowing for the reappropriation of its $250,000 share of such projects, so that it could in turn be paid to the federal government. The State Legislature, being about as dilatory as its national counterpart, didn't get this done until 1898.

During the ensuing years the California Debris Commission prepared plans and specifications for a series of engineering projects designed to halt the flow of mining debris into the valley's major rivers. These were begun in 1902. In the meantime, working as it did with limited funding, the Commission concentrated upon its role of licensing hydraulic operations and bringing to a halt all illegal hydraulicking.

Besides the very practical problems of getting to the mountains for the purpose of on-site inspections, the Commission was faced with a pair of other problems. One issued from the fact that no specific standards had been adopted for the construction of restraining works. The engineers, therefore, had to inspect and evaluate each dam in terms of its individual characteristics and then make a judgment about its relative strength and capacity.

This proved to be extremely time-consuming and also left the Commission open to charges of subjective evaluation. The second area of difficulty had to do with the failure of the early debris dams. A section from the Debris Commission's annual report for 1896 illuminates both problems.

> The Commission has, since it organized, received 224 applications to mine; 166 permits to mine have been granted . . . Four permits have been canceled and twenty-five permits have been at different times temporarily suspended, generally on account of the neglect of the owners to comply with instructions concerning the impounding works, or from accidents to those works.
>
> Several dams or other impounding works have been broken or otherwise damaged, but with one exception only small quantities of material escaped into navigable streams. This was the dam of the Omega mine in Scotchmans Creek, Nevada County, which broke owing to the caving in of an old wooden shaft built before the dam authorized by the Commission was constructed. Only a few thousand cubic yards of material had been placed behind the authorized dam, but its breaking permitted the escape of about 100,000 cubic yards of material impounded some years ago, and upon which the authorized dam had been constructed.
>
> *(Appendix YY Annual Report of the California Debris Commission for 1896)*

Such dam burstings did not go unnoticed by the anti-debris interests. Not only were they critical of the engineers for not requiring stiffer regulations, they also openly charged that the miners were deliberately destroying their own dams so that they could clear the area of debris — thus allowing more room for new debris.

After about a decade of experience dealing with debris dams and their construction, the Commission settled upon two basic designs — log crib dams and brush dams.* With few exceptions, these constituted the vast majority of the debris dams built by the miners to hold back debris. And because these new designs were more substantial than the earlier ones, the cost to the mine owners increased. Some miners chose to ignore the Commission's directives and tried to get by with lesser works.

Log crib dam.

For its part the Commission remained vigilant. During 1905 some 39 licenses were temporarily suspended for various causes, and 700 personal inspections of mines made. Even where partial dam failures occurred, the owners were immediately required to suspend operations and make necessary repairs.

In cases where the Commission's orders were ignored, legal action was taken. Such situations developed in both Nevada and Plumas Counties in 1905.

> Three of these cases were in Nevada County and one in Plumas County. Proceedings were instituted at the request of the Commission by the United States district attorney in these cases, which resulted in the arrest of all the persons implicated.
>
> Of eight persons already examined, six of those implicated in the three cases in Nevada County were bound over for trial under $500 bonds by the United States commissioner before whom the preliminary hearings in those cases were held. The preliminary hearing of the case in Plumas County is set for July 25, 1905.
>
> These are the first criminal proceedings that the Commission has found necessary to institute. It is believed that they will have a decided effect in deterring others from engaging in illegal mining operations.
>
> *(Appendix AAA, Annual Report of the California Debris Commission for 1905)*

The promised boom was over. Frustrated by unfavorable litigation, scrutinized at every turn by the anti-debris agents and regulated by the California Debris Commission, the hydraulickers all but gave up. Even though the Commission continued to approve applications, the vast majority of those seeking permission to mine engaged in relatively little washing. Often, in fact, once a permit was received, no mining was done at all. Within a few years after the turn of the century, the industry was nearly dead; it only remained for it to finally breathe its last and to receive a decent burial.

It was indeed prophetic when Anthony Caminetti, speaking in defense of his bill in 1893, stated that "the people of California do not yet realize what a tremendous advantage this bill is going to be to them. It is usually spoken of as a measure for the benefit of miners, but its provisions for the

* See Appendix B for a full description of these types of dams.

896 Fillmore St., San Francisco, Cal.,

May 14, 1906.

The Commission met at 1:30 P. M. today. Present, all the members

This being the first meeting of the Commission since the destruction of a large portion of San Francisco by fire, in which the books and property of the Commission were all destroyed, no minutes of the previous meeting were read.

The correspondence since the last meeting was read and the action taken thereon approved.

The Commission took the following action upon matters brought before it: That the temporary office of the Commission should be located in flat No. 896 Fillmore Street, San Francisco, until such time as other offices were deemed necessary; that W.H.Hammon should be notified that Daguerre Point Cut was opened on May 1, 1906, and that he will be expected to complete his barriers on the Yuba River by December 1, 1906; that $5,000.00 additional for the current expenses fo the fiscal year of 1907 should be asked for from the Chief of Engineer making the estimate of the Commission's expenses for that fiscal year amount to $20,000.00 instead of $15,000.00, as heretofore; that the attention of the Chief of Engineers be invited to the fact that a bil is at present before Congress calling for the survey of the Sacrament Valley, and that the Act of March 1, 1893, has already provided an organization to carry out such work as is covered by the Act now unde consideration.

The Commission then adjourned.

Captain, Corps of Engineers,U.S.Army,

Secretary.

Revocable License

No. _____

By virtue of authority conveyed by act of Congress approved March 1 1893 the California Debris Commission hereby issues a License to _____

_____

to Mine by the Hydraulic Process in the _____. Mine, near _____ County, California.

The operations of this mine are to be conducted in accordance with the instructions that may from time to time be given by the California Debris Commission.

San Francisco Cal.,

_____
Corps of Engineers U.S.A.
President of the Commission

_____ 190_

THE CALIFORNIA DEBRIS COMMISSION having received applications to mine by hydraulic process from Francis Mining & Investment Co., in General Harrison Mine, near Johnsville, Plumas County, California, draining into Nelson Creek; from Sunny Side Mining Co., in Sunny Side Mine, near Pleasant Valley, Eldorado County, California, draining into Clear Creek; and from Joseph Brown, in Brown's Flat Mine, near St. Louis, Sierra County, California, draining into Slate Creek, gives notice that a meeting to receive any protests will be held at No. 1733 Pine St., San Francisco, Cal., November 26, 1906, at 1:30 P. M.

1733 Pine St., San Francisco, Cal.,

November 26, 1906.

The Commission met at 1:30 P. M. today. Present, all the members.

This being the date set for receiving protests against mining by the hydraulic process at the Sunny Side Mine, General Harrison Mine and Browns Flat Mine, no protests were received.

The minutes of the previous meeting were read and approved.

The substance of the correspondence since the last meeting and the action taken thereon was read and approved.

The Commission took the following action upon matters brought before it: that the owners of the Omega Mine should be required to raise the crib work of the spillway at the tunnel entrance and the main restraining dam, so there will be at all times a pool of water at least five feet deep; that the owners of the Sunny Side Mine should be required to raise their three brush dams two feet each, to provide for the coming season's operations; that the operators of the General Harrison Mine should be required to build a log crib dam at least 15 feet high; that the license of the Sugar Pine Mine should be suspended; that the owners of the Esperance Mine should be authorized to fill their present dam up to within two feet of its crest and then raise it 10 feet, the limiting height to be 35 feet; that the license of the Clapboard Gulch Mine should be suspended until the dam is raised six feet; that the license of the Orchard Placer Mine should be suspended until the dam has been raised five feet and the work completed in accordance with specifications; that license should be issued for the Telegraph & Hickey Mine.(749)

The Commission then adjourned.

Major, Corps of Engineers, U.S.Army,

Secretary.

503 Market St., San Francisco, Cal.,

May 10, 1909.

The Commission met at 3:15 p.m. today. Present, all the members.

The minutes of the last meeting (April 27) were read and approved.

The correspondence requiring the action of the Commission was read and the following action taken: That the license of the Depot Hill Mine (127) be revoked on account of failure of operator to keep a pool while operating; that the licenses of the following mines be revoked on account of no future operations: Yellow Jacket (807), Gaylord (775), Republic (794), Spanish John (80), Gold Run (805), San Domingo (784), Denmark Placer (809), Southern Cross (786), St. George (708), Imperial (718), Salt Creek and Flat Gulch (800), (14) Moosehead (725), Home (780) and Brown Bear (801); that the licenses of the following mines be suspended on account of no further work this season: Lone Star (835) and Wallace Canyon (763); that the authority to construct dams granted the following mines be recalled, no work having been done, or work having been abandoned: Necoe & West (843), El Dorado (836), Yuba (828), Corbiere and Bean (9), Clark Placer (839), Paragon (826), Lancha Plana (565), Trayner Placer (798), Lone Star (829), Concordia (830); that the licenses of the following mines be restored: Wah Kee (792) (pending inspection) and Philo Haven (528).

The Commission then adjourned.

Thos. H. Dartnell

Captain, Corps of Engineers, U.S. Army,
Secretary.

improvement of the rivers will be found to be still more important." (Grass Valley *Daily Union*, February 8, 1893). We can never know with certainty if Mr. Caminetti actually believed his own pronouncements, but his prediction has been borne out by history. No amount of legislation would ever revive the hydraulic industry. On the other hand systematic river management dates from the time of his bill.

By 1908, the combined production for drift, hydraulic and all other (gold) gravel mining had fallen below $1,000,000 annually. By 1924, hydraulic mines for the entire state produced only $60,195 in gold, and during the next year production advanced to merely $175,345. For the six years, 1920 through 1925, gold production as a result of hydraulic mining averaged $122,144 per annum, and of this amount less than $60,000 was mined in the counties that drain into the valley. The major portion of the total production was produced in counties that were not subject to restrictions, because their rivers emptied directly into the Pacific Ocean. Thus it was that in little more than 40 years, gold produced by the hydraulic method dropped in value from $10,000,000 to $122,000 annually. For all intents and purposes then, hydraulicking had ceased to be of substantial importance to the state by 1920. Even so, scores of applications were filed with the Commission during these years, and in many cases licenses were secured from the CDC to mine. Especially was this true during the years of the Great Depression when men returned to the mountains in hopes of scratching out a living. Unemployment, cheap labor and the increase in the gold price, from $20.67 to $35.00 per ounce, during the decade of the 1930s were the major factors leading to a renewed interest in hydraulicking.

Another facet of the California Debris Commission's regulatory function must be noted if a full discussion is to be rendered. This additional role was the relationship of the Commission to gold dredging, which began to flourish as an industry during the period of decline suffered by the hydraulickers.

A gold dredge is a box-like floating machine whose hull is about three times as long as it is wide. Large dredges have

RISDON GOLD DREDGE

This highly successful Dredge is the evolution of thirty years, each succeeding Dredge being an improvement upon its predecessor, until absolute perfection seems to have been reached in the Risdon Gold Dredge.

There is no other method by which ground can be handled so cheaply, whether in river-bed or where the seepage is sufficient.

The buckets are water-tight saving all the gold while the bucket is being elevated. Has the best possible hopper to wash and properly treat the material which is dumped into it intermittently in large quantities. The gravel passes over the tables or gold-saving devices in an even and uniform stream, so nothing is lost. Can be operated at a cost of 3 cents per cubic yard.

MANUFACTURED BY

THE RISDON IRON WORKS

SAN FRANCISCO, CAL.

SEND FOR CATALOG No. 17.

FROM: *California Mines and Minerals - 1899*, p. 1

Risdon gold dredge working inland, Oroville District.

hulls that draw from 9 to 11 feet of water and operate by means of spuds. These spuds are huge anchoring piles of iron or steel that hold the machine in place as well as allow it to swing from side to side, move in a circle and/or step forward.

During the last quarter of the 19th century, serious attempts were made to develop a machine which could bring up gold-bearing gravel from far below the water surface of the streams on which gold-bearing gravel was found. Men also looked for ways to incorporate means by which these machines would separate free gold from the vast quantities of gravel dredged. While the period of dredger development actually spanned the years from about 1858 to 1895, little real success was achieved until the last decade of the century.

Few records remain of the construction and operation of the first dredges. It is known that much of the early experimenting with dredges in America was done on the Feather River in the vicinity of Oroville, California. Generally, the first efforts failed. It has been claimed in fact that some of the early-day gold dredges couldn't operate at a profit in grounds that tested 30 cents per cubic yard — 30 cents per yard being a very high value, considering the relatively modest price of gold in those days, which was about $19.00 per ounce. During these same years, the hydraulickers were turning a profit from ground valued at less than half of the "30 cent ground" available to dredgers.

The first really successful endless-chain bucket dredge constructed on the Pacific Coast was a machine designed by R. H. Postlewaite, an engineer from New Zealand, and built by the Risdon Iron Works of San Francisco. Fabricated for the Feather River Exploration Company, the dredge began operations near Oroville on March 1, 1898. During this same period, Mr. Postlewaite tried his hand at dredging near Smartville on the Yuba River above Marysville. While the dredge itself was considered satisfactory, actual mining conditions failed to allow for financial success. From the turn of the century on, dredging enjoyed tremendous success in California, especially on the Feather River near Oroville, on the Yuba near Marysville and on the American River near Folsom.

Although gold dredging did not fully qualify as "hydraulic mining" under either California state or federal law, a very extensive use of water is made in the operation of a gold dredge.* Also, aboard a gold dredge are all, or nearly all, of the equipment and machinery used by the hydraulic gold miner in his ordinary mining operations. Moreover, gold dredges float continuously on water even when they are being moved from place to place. Accordingly, it is (and was) most difficult to support a definition that included dredging as a branch of hydraulic mining.

For a number of years the California Debris Commission believed that gold dredging did in fact fall within the provisions of the Debris Act of March 1, 1893. Acting in accordance with this position, the CDC inspected many dredging

Bucket ladder of gold dredge in operation.

* By legal definition, hydraulic mining is the action of water *under pressure* against a natural bank.

Ore cars — those suspended from overhead cables and those that ran on tracks — carried rich ore from the quartz (hard rock) mines. For some years the CDC inspected these mines to ensure that debris did not escape the area. (Author's photos)

operations and issued (War Department) permits when it deemed such action appropriate.

The Debris Commission followed this line of reasoning until the early 1920s, at which time an apparent change in philosophy matured. Accordingly, it stopped the practice of issuing California Debris Commission (War Department) permits for gold dredging. An exception to this new procedure was the Yuba River, where the Commission continued to issue permits for dredging because it firmly believed that the federal government held sufficient property rights on that stream to justify such action. Subsequently, the regulation of gold dredging on streams, other than the Yuba River, which drain into the Central Valley was given to the Third San Francisco District — the immediate predecessor of the Sacramento District, U.S. Army Corps of Engineers.

The District's authority for assuming this task was contained in Section 13 of the River and Harbor Act of March 3, 1899, which reads in part:

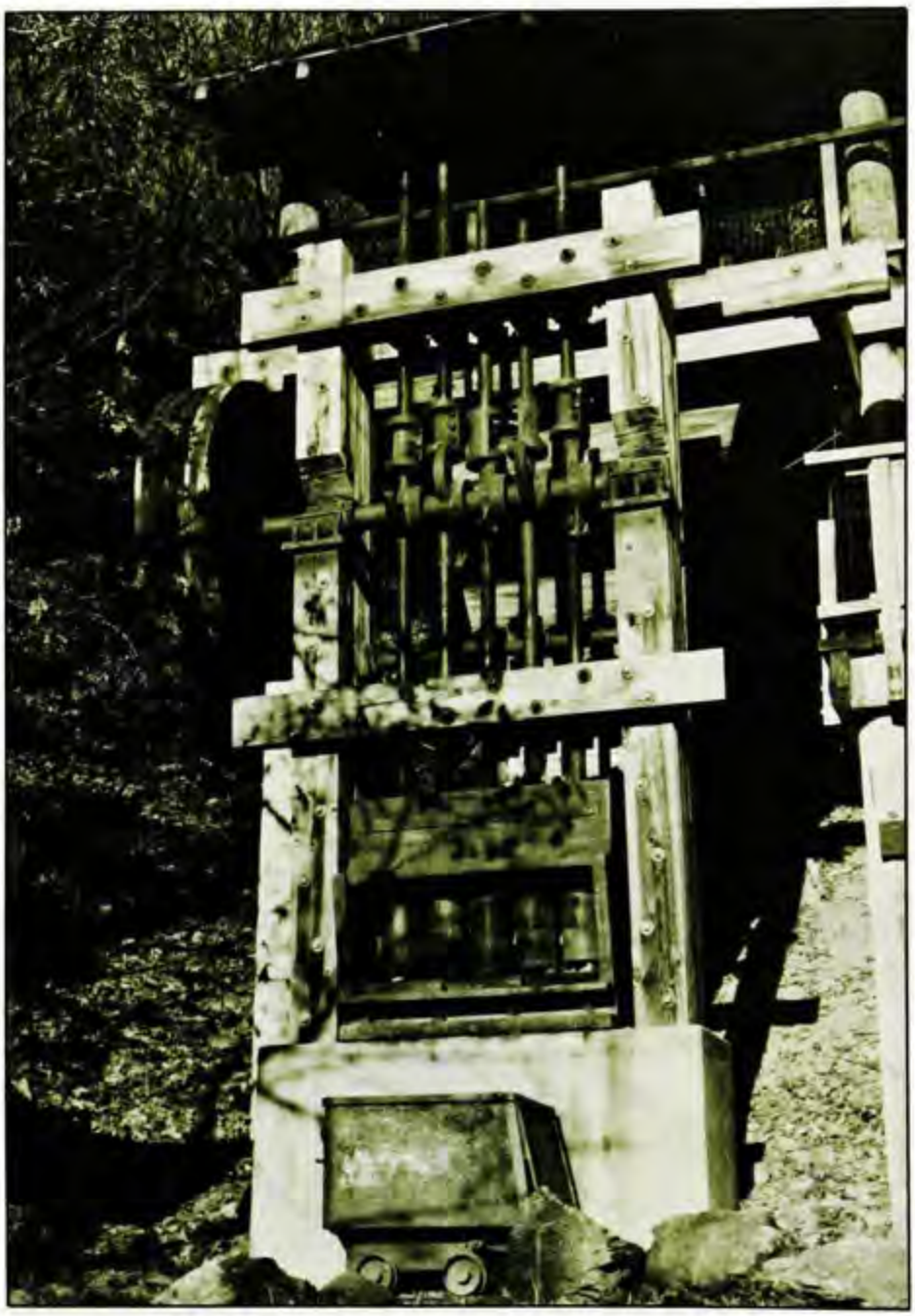
> That it shall not be lawful to throw, discharge, or deposit any refuse matter of any kind or description . . . into a tributary of a navigable water . . . from which the same may be washed or float into such navigable water; and it shall not be lawful to deposit material of any kind on the bank of any navigable water, or upon the bank of any tributary of any navigable water, where the same may be liable to be washed into such navigable water. . .

Even though the Commission ceased issuing new permits in the early 1920s for dredging operations, it did continue to inspect the gold-dredgers until the mid-1930s. In addition, the officers of the CDC tramped throughout the mountains checking on quartz miners. A brief passage from the CDC Annual Report for 1926 is illustrative:

> Operations of gold-dredging companies . . . were supervised. Eleven inspections of gold-dredging plants and eight inspections of quartz-mine debris-restraining barriers were made.
>
> Thirty-three quartz mines have constructed restraining barriers under plans approved by the commission to permanently prevent the passage of their tailings to navigable streams. It is not yet

possible to regulate all such operations, but supervision will be extended as time and funds permit.

The problems created by the mountain of debris, whether the product of hydraulic or quartz mining, did not end simply because the nozzles were being shut off, mines inspected, and dams built. Between 1853 and 1909 the hydraulic mines alone poured approximately 1,555,000,000 cubic yards of debris into the streams of the western Sierra, the equivalent of eight times the volume of material excavated to dig the Panama Canal. Stated another way, this is sufficient dirt, sand and rock to build a road a mile wide, three feet deep that would stretch from San Francisco to the Mexican border. So after 1902, the California Debris Commission focused its attention on the glacier of debris and began to take steps to arrest its progress toward the valley.



The Eby Stamp Mill, located in the Feather River Canyon, reminds travelers that these appliances once pounded raw ore of the Plumas County area into fine particles that could then be processed. (Author's photo)

Chapter V

Improvement and Protection of the Rivers

Yuba River

The Yuba River, a tributary of the Feather, which in turn is a major tributary of the Sacramento River, was the first selected for rehabilitation.

The Yuba was filled with more debris and carried more detritus than all the other tributaries of the Sacramento combined. Thus it was only reasonable to prepare and execute plans for its improvement before any others. The legislation that authorized this initial work to be done stemmed from an act passed by Congress on June 3, 1896, wherein the Debris Commission was given special powers as a "River Board" to develop specific plans for the improvement of the Sacramento and Feather Rivers. The Commission (Board) carried out further investigations, while at the same time reviewing earlier surveys conducted by the Corps of Engineers and the State of California. The report of the Commission relative to investigation of sites for restraining works in the Yuba River was submitted to Congress on January 30, 1900. (Printed as House Doc. No. 431, Fifty-sixth Congress, first session.)

Initially the Commission* believed that a single large storage dam/reservoir would provide the needed answer. Attention was focused upon the "Narrows" of the Yuba River, a precipitous gorge located just upstream from the little village of Smartville in Yuba County. The Narrows had for years been perceived as a natural dam site. In the autumn of 1897, the Commisson sent Assistant Engineer Hubert Vischer, a civilian, to the area to carry out a thorough investigation of the Narrows site. Acting under the direction of the Commisson, Vischer spent almost a year drilling and digging shafts, borings, tunnels and drifts. He then prepared estimates and designs for a dam, with a diversion project for carrying the finer debris material to a settling basin 28 miles distant. Vischer's work became known as the "1898 Project."

Progress reports were made to the Commission nearly every week that Vischer was in the field. Upon receiving the engineer's final report, the Commission reevaluated its initial position and began to look at a simple but more comprehensive project than the "1898 Project." Essentially the Narrows site was seen in a less favorable light because of the following factors:

1. difficulty and expense of obtaining a suitable foundation;
2. limited storage capacity of the contemplated dam/reservoir;
3. uncertainty of being able to store the lighter debris and none of the immense quantity lying in the river bed below the dam site;
4. the excessive cost of the whole project (over a million dollars), which involved boring tunnels, building flumes and canals, transportation of the finer materials by water through these works to a settling basin of very limited capacity.

Even while the "1898 Project" was being finalized, Colonel Mansfield and the members of the CDC were giving increased attention to even a newer idea formulated by Vischer: the storage of mining debris within the bed of the Yuba River. This new concept was soon labeled the "1899 Project." The major features of this project included:

1. storage of the mining debris within the bed of the Yuba river;
2. control of the low water channel within well-defined limits;
3. the erection of several barriers of modest size across the bed of the river, specifically:
   a. barriers No. 1 and No. 2 to be located some 3 miles east of the mouth of Dry Creek,
   b. a barrier to be built just below the mouth of Dry Creek,
   c. a barrier to be placed at Daguerre Point,
   d. constructon of a settling basin about 3 miles by 1½ miles wide on the south side of the river,
   e. the building of training walls below the basin to confine the river channel within well-defined limits.

The Commission felt that the entire project would cost about $780,000 (exclusive of the required land) and would be capable of storing millions upon millions of cubic yards of debris. Interestingly enough, the engineers employed their Annual Report for 1900 as a vehicle to point out that such a concept was without precedent.

> The project as submitted is novel, since nothing of the kind, so far as known, has ever been attempted, and it is to a certain extent experimental. The various structures are simple, and are believed to be safe, practical, and reasonably permanent. They can be repaired if required, and if abandoned, not maintained, or never completed, cannot leave the river in any worse shape than at present. If constructed, it is believed that they are capable of storing the debris now in the Yuba River and its tributaries, which is far in excess of that in all the other tributaries of the Sacramento River.
>
> (Annual Report of the Chief of Engineers, U.S. Army — Appendix AAA - Report of the California Debris Commission — 1900)

As part of their report, the Commissioners were quick to point out that "the object sought to be accomplished is the storage of the detritus now in the Yuba and its tributaries, with a view to the improvement of the rivers below, and decidedly not with the view of permitting unlicensed or indiscriminate hydraulic mining. . ." Members of the CDC felt that the prudent thing to do was to build the project, and then to monitor the situation for several years before making a determination relative to future mining. Finally the Commission summed up its feelings by stating that the project was practicable, worthy of adoption and that it was recommending construction as early as funding was secured.

On June 27, 1901, the River and Harbor Committee of the House of Representatives, accompanied by the Debris Commission, state officials and a large party of interested citizens, inspected the proposed sites for the impounding barriers. There they saw the immense deposits in the river and viewed some of the pits of the old hydraulic mines, as well as the extensive levees built on both sides of the river to protect the adjacent lands and the city of Marysville from inundation. As the group toured the region, the Commission explained the proposed plan and outlined just how it was to be carried out.

The engineers had since the fall of 1900 been negotiating for the necessary land — some 4,000 acres (later 10,000) belonging

* As of January 30, 1900, the Commission consisted of Colonel S.M. Mansfield, Major W.H. Heuer and First Lieutenant Herbert Deakyne.

to over 40 different owners — upon which the dams and other works were to be built. They had in fact already secured title to about a fourth of the needed property by the time the committee visited the sites in the summer of 1901.

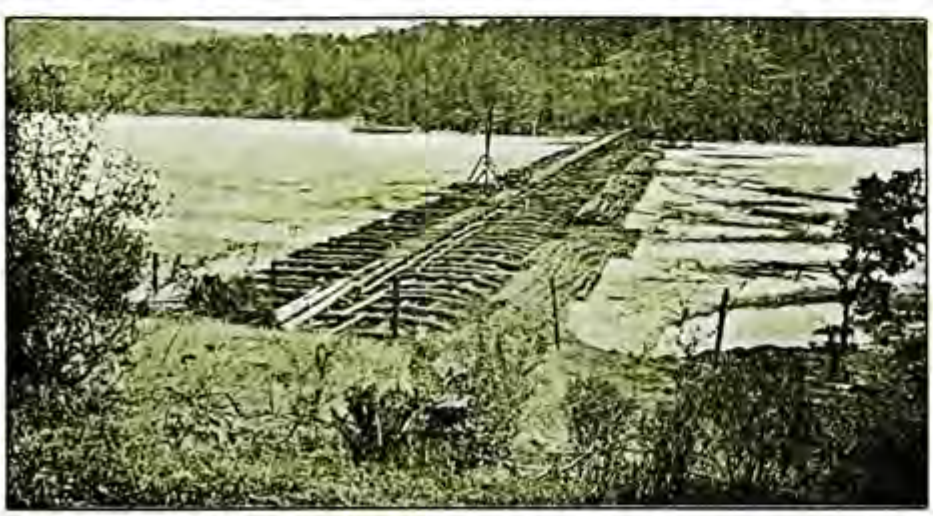
With first-hand knowledge of the situation, the House Committee for Rivers and Harbors had little difficulty in convincing the full Congress of the desperate need to take corrective action on the Yuba near Marysville. On June 13, 1902, an act was approved to restrain the debris in the bed of the river. As initially drawn, the approved plan envisioned four barriers being built across the Yuba, the dredging of a settling basin and the building of training walls to guide the river in a desired course. In addition, a cut was to be made through the promontory in the river known as Daguerre Point to provide a flood-overflow channel.

A contract for the first work on *Barrier No. 1* was entered into with the Atlantic, Gulf and Pacific Company on November 3, 1902. The contract called for the construction of a barrier of gravel and brush faced with rock, about five feet high above the river bed, and an apron, on the downstream side, of brush covered with rock and protected by a double row of sheet piling extending across the river. On account of the difficulty of placing the sheet piling, the contract was later revised.

Barrier No. 2, Yuba River, Cal., October 3, 1903. Showing construction of brush fascine pockets under contract with Samuel Montgomery, dated August 17, 1903.

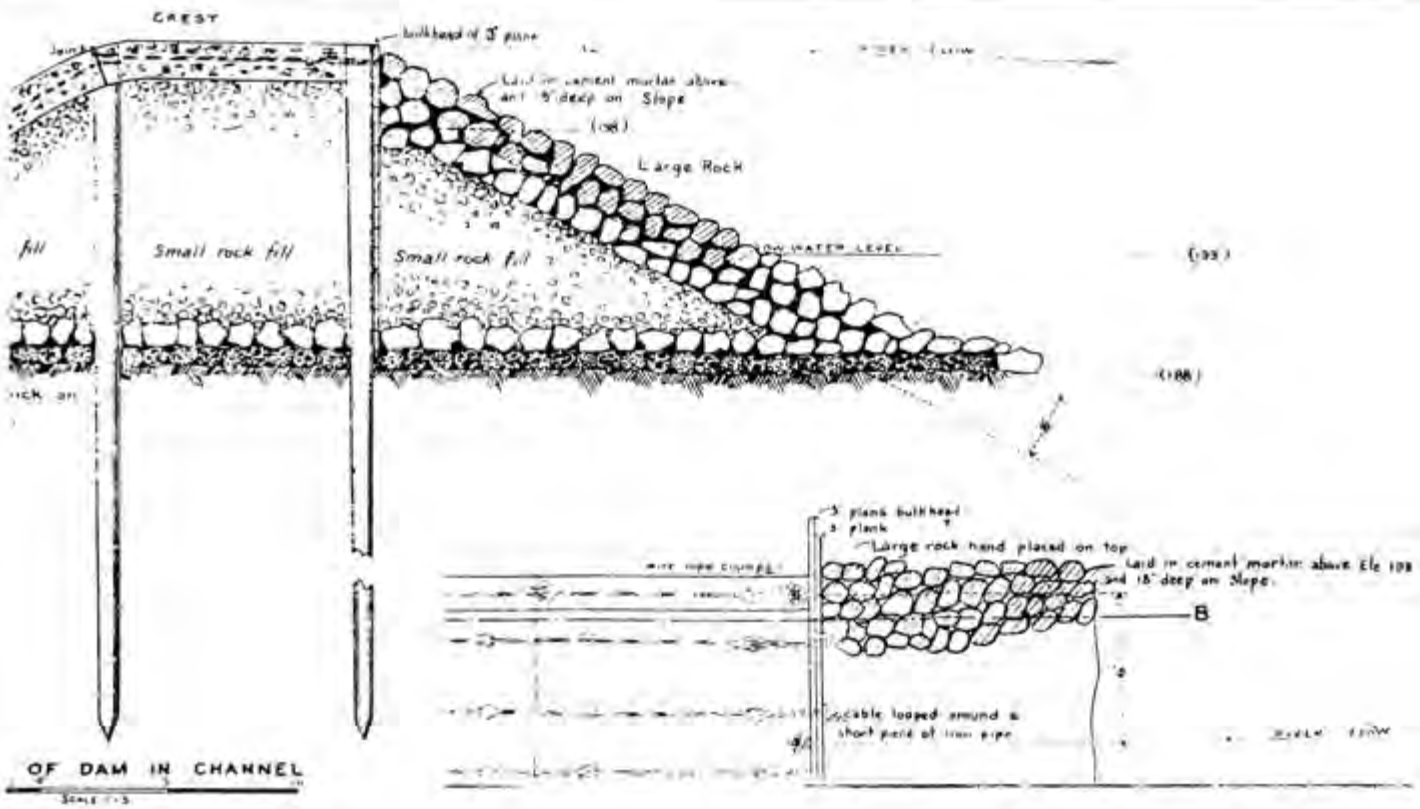
Specifications for the construction of portions of Barriers No. 1 and No. 2 under the revised plan were approved by the Chief of Engineers on July 10, 1903. Bids were called for, but because of the lateness of the construction season, an emergency contract for the work was signed with Samuel Montgomery on August 17, 1903. The new contractor was to furnish and place the materials necessary for a barrier 950 feet long, extending from the south bank of the river to a spur of brush and stone about 400 feet long, constructed during the previous year on the north bank under the contract with the Atlantic, Gulf and Pacific Company.

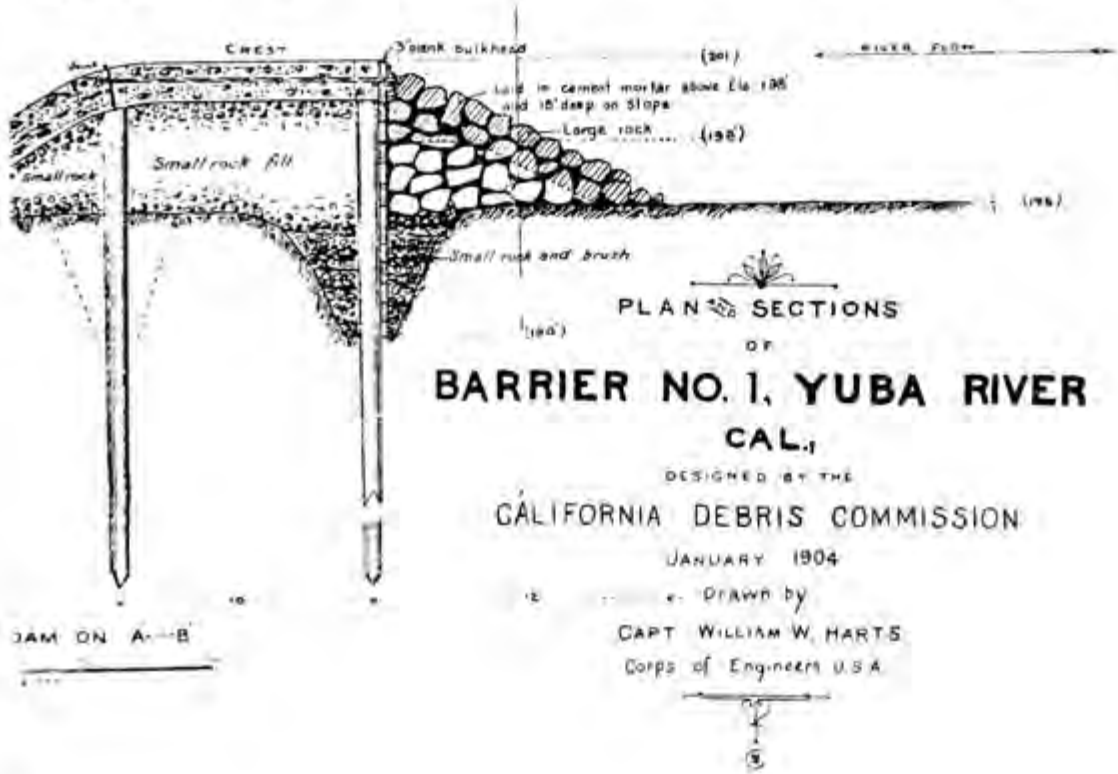
In general, the plan for Barrier No. 1 provided that it should consist of brush fascines* a foot in diameter, made of brush and strong poles, strongly compressed and wired every three feet, and then built into a crib-like structure to form pockets, each about four feet deep and five feet square. These pockets were to be filled with loose rock, thus forming a barrier extending entirely across the river. This barrier was to be 36 feet wide and its top was to be five feet above the general level of the river bottom. Extending across the river, along the downstream side, there was to be laid an apron 16 feet wide made of brush fascines a foot in diameter, laid closely together, parallel with the flow of the river, one fascine deep and fastened to each other with wire ropes at intervals of about four feet. This apron was supposed to prevent scour of the river bottom immediately below the rock-filled fascine cribwork when the river flowed over the barrier.



Barrier No. 2, Yuba River, Cal., looking toward South Shore, October 3, 1903. Barrier in course of construction under contract with Samuel Montgomery, dated August 17, 1903.

* A long bundle of sticks of wood bound together.





PLAN & SECTIONS
OF
BARRIER NO. 1, YUBA RIVER
CAL.
DESIGNED BY THE
CALIFORNIA DEBRIS COMMISSION
JANUARY 1904
Drawn by
CAPT WILLIAM W. HARTS
Corps of Engineers U.S.A.

Mr. Montgomery began work on Barrier No. 2, located about a half mile above No. 1, in September 1903, and shortly thereafter on No. 1. Unfortunately for the contractor, unusually high water came down the Yuba on November 12, 13, and 14, 1903, and destroyed much of the work completed. As the materials had not been accepted by the Commission, Montgomery had to stand the loss. To correct at least part of the damage, yet another emergency contract with Lewis Moreing was signed in mid-October.

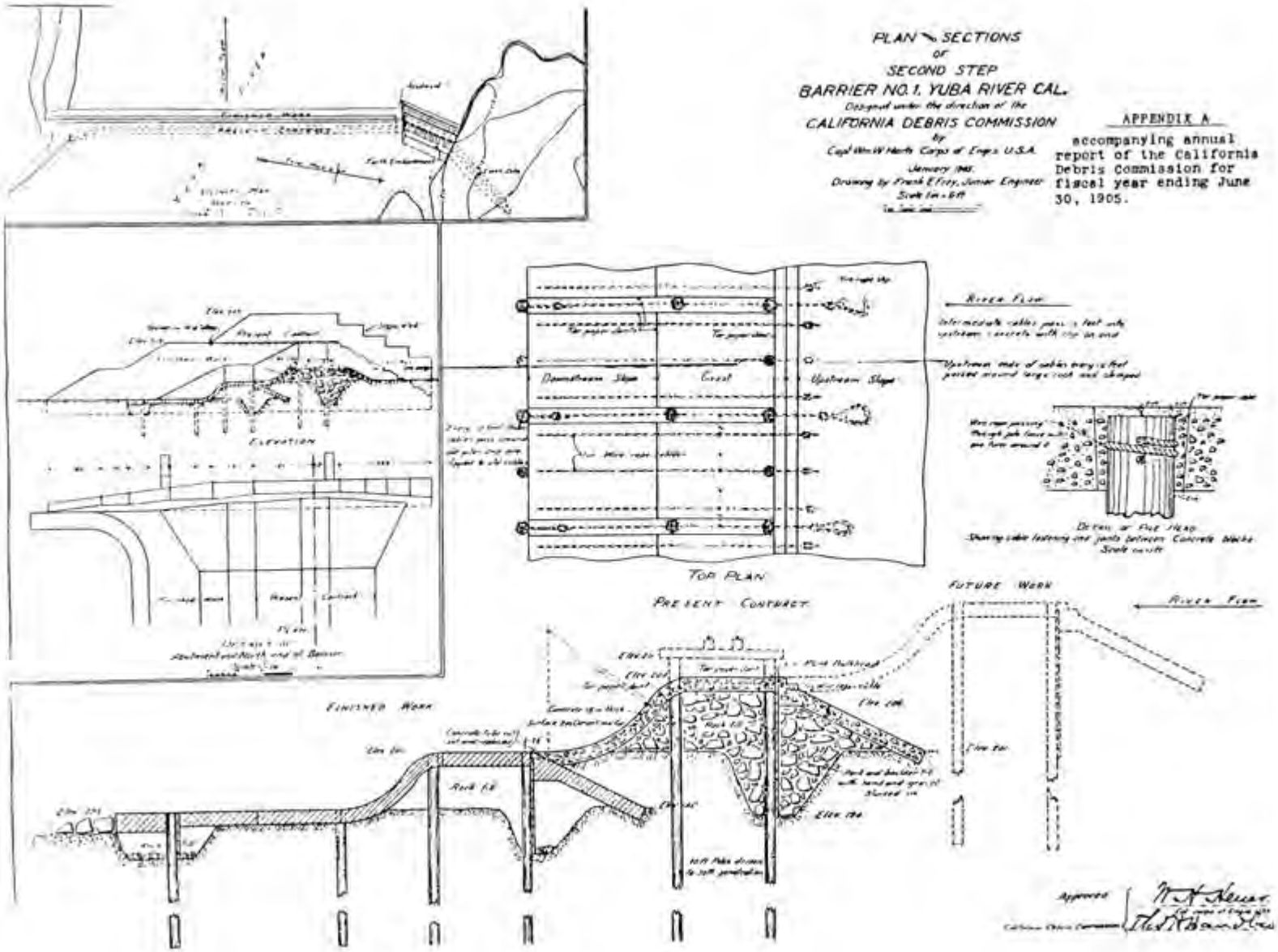
In view of the damage done to the barriers it was deemed prudent to revise the designs so that the new structures could withstand the flood of the Yuba. Experience to that time indicated that piles with good penetration would be necessary to anchor the barriers to the river bed.

The new plan provided that Barrier No. 1 (Barrier No. 2 was scrapped) would consist of four parallel rows of piles extending across the river bed and would have a minimum of 20 feet penetration. These piles were to be fastened together by wire cables one inch in diameter. The space between the first and third rows of piles was to be filled to a subgrade with rock and cobbles having gravel and sand sluiced in the interstices forming the main body of the barrier. The area between the third and fourth rows was to be graded down to receive an apron, so that the latter would be almost flush with the river bed when completed. Over the entire barrier, an 18-inch layer of concrete was to be placed, in block fashion, and held together by one-inch cables. The finished barrier was designed to have a crest length of about 1,200 feet and was to be approximately six feet high and ten feet wide across the top.

The 888 piles used in the "first step and apron" of Barrier No. 1 were purchased in southern Oregon and brought to Marysville by rail. From there they were hauled the 17 miles to the construction site by four- and six-horse teams. Each pile cost about $12 by the time it was unloaded at the job site. The cost of driving the piles was $5.02 each, making the average cost for the piles, furnished, delivered and driven, about $17 each. On the average, six piles were driven each day (maximum of 15 in a single day) using a 3,200-pound pile driver hammer operated with a 20-horsepower hoisting engine.

The first pile was hammered into place on February 8, 1904. Things didn't go as well as they might have, because on the 22nd of the month, high water overturned the rig and carried it 300 yards downstream. The machine was finally recovered and work was begun anew on March 16. From June 2, 1904, until August 1, 1904, a pair of crews was employed — the first working from 4:00 a.m. till noon, and the second hammering away from noon until 8:00 p.m. The last pile was set on August 11, 1904. High water late in September caused a delay in completing the rock and cement work, but after several setbacks the first step of Barrier No 1 was completed in October 1904.

Ancient wagons such as these abandoned near the Yuba River once carried piles and other materials to the construction sites for the Yuba River Barriers. (Author's photos)


PLAN & SECTIONS
OF
SECOND STEP
BARRIER NO. 1. YUBA RIVER CAL.
Designed under the direction of the
CALIFORNIA DEBRIS COMMISSION
By
Capt Wm W Harts Corps of Engrs U.S.A.
January 1905.
Drawing by Frank E Frey, Junior Engineer
Scale 1in = 6ft
APPENDIX A
accompanying annual report of the California Debris Commission for fiscal year ending June 30, 1905.
Elevation
Downstream Slope
Crest
Upstream Slope
River Flow
TOP PLAN
PRESENT CONTRACT
FUTURE WORK
River Flow
FINISHED WORK
Approved

Barrier No. 1 — Yuba River, September 1901. High water passing over unfinished dam.

During 1905 a second step, similar to the first, was completed, making the barrier 14 feet high. Once this had been accomplished it was planned to build a third to stop the scour action of the river near the barrier. In the spring of 1906 work was begun on a spillway as a further measure to improve the design of barrier No. 1. Once again, however, all of the work that had gone into this debris-control structure went for naught. During March of 1907 disastrous and widespread floods occurred throughout central California. The Yuba rose to record heights and destroyed 600 feet of Barrier No. 1. To make matters worse, millions of cubic yards of debris, held in place by the barrier, were washed downriver. When the flood subsided, the engineers decided to give up on the Barrier No. 1 site, and instead proposed to complete a barrier at Daguerre Point (No. 4 of the original proposal) and the settling basin immediately below. The training walls below the Daguerre Point cut (flood channel) were also to be completed. In other words, the "1899 Project" was revised so as to concentrate the Commission's effort at and near Daguerre Point.

Over the next few years the cut through Daguerre Point was completed and a concrete inlet wall (spillway) constructed. Later this inlet wall was raised about 16 inches and covered with a wooden deck. Cobble training walls on each side of the river below the cut were built for some 12,000 feet. The entrance gates to the settling basin were constructed, most of its inclosing levees were built, and the outlet works were practically completed when this part of the project was found no longer necessary and was abandoned under authority of the River and Harbor Act of June 25, 1910. The land acquired for the settling basin was then sold, together with the intake and outlet works.

After 1910 the river channel from the lower end of the training walls to Marysville was cleared of brush and trees at various times, and hardpan blasted from the river bed. This was done to enable the high water to move from the vicinity of the works at a fast rate, while enabling the river to cut a deep permanent channel along definite lines. Several old sand channels were cut off from the river by placing levees across their heads, thus preventing the flood waters from carrying out the sand and debris deposited in those channels. It is interesting to note that the training walls built on the south side of the river were completed by the Yuba Consolidated Gold Fields and the Marysville Gold Dredging Company as part of their gold dredging operations. Finally, the Yuba Consolidated Gold Fields Company also built a training wall (rock levee) which took the place of Barriers No. 1 and No. 2.

Excerpts from the Commission's report of 1917 outline the type of work typically completed during this period.

> . . . the inlet wall at Daguerre Point Cut was further protected against undermining by additional concrete slabs being made in place at the toe . . . Below the training walls embankments were thrown up across the heads of two old channels. Between Marysville and the Daguerre Point the river channel was cleared of snags, trees and brush were cut from the banks . . . blasting of hardpan in the bottom of the river channel was done . . .

Daguerre Point Cut, August, 1904.


THE California Debris Commission having received application to mine by hydraulic process from Western Steel Dam Co. in Goldbend Mine, near Bagby, Mariposa County, Cal., draining into Merced River, gives notice that a meeting to receive any protests will be held at 703 Market St., San Francisco, Cal., Nov 23, 1909, at 1:30 p. m. 431148

503 Market St., San Francisco, Cal.,

Jan. 24, 1910.

The Commission met at 2:30 P. M. Present, Colonel Biddle and Captain Jackson.

The minutes of the last meeting (Nov. 9, 1909) were read and approved.

Nov. 23, 1909, being the date set for receiving protests against mining by the hydraulic process at the Goldbend Mine (857), no protests were received.

The correspondence requiring the action of the Commission was read and the following action taken: That licenses be issued to the Noose and West Mine (843) and Calaveritas Hill Mine (850); that the license of the Kenross Mine (814) be restored; that the operators of the Dondero Placer Mine (858) be required to do the work called for in report dated Jan. 19, 1910; that the operators of the gold dredge at La Grange be required to conduct their operations in accordance with the report of Jan. 19, 1910; that permission be granted Byron Jakes and F. D. Groh to place a culvert through the North Training Wall, subject to the conditions of their application and the report of Jan. 24, 1910; that the instructions in letter dated Jan. 12, 1910, to the operators of the Blue Ravine Mine (818) are confirmed; that the restoration of the license of the Coon Hollow Mine (849) is confirmed; that the operators of the Green Valley Mine (859) be required to do the work recommended in report of Jan. 6, 1910.

The Commission then adjourned.

Thos. H. Jackson
Captain, Corps of Engineers, U. S. Army,
Secretary.

The bank of the Yuba River at one place was revetted for about 540 feet, to keep the river from cutting into an old sand channel . . . The westerly 3,200 feet of the north training wall — the portion that is not reinforced by dredge tailings — was given attention. Trees that had grown large enough to be of detriment to the embankment were cut down, willows were planted to protect it from wash, and a brush mattress was placed on the extreme westerly end of the embankment . . . A portion of the river, from Daguerre Point to the vicinity of Marysville, was surveyed . . . All of the work was done by hired labor, except the embankment work, which was done by men, teams, and scrapers obtained under informal agreement at the rate of $7.00 per day for man, four-mule team, and scraper.

(Annual Report of the Chief of Engineers, U.S. Army, 1917. California Debris Commission)

The project, as modified, was completed in 1935. By that time there existed three training walls having a total length of 85,100 feet which provided two 500-foot channels. The result of the work on the Yuba in and around Daguerre Point has been to hold millions of cubic yards of mining debris in the Yuba River which would otherwise have passed into the navigable channels of the Feather and Sacramento Rivers.

Sacramento River

"The interests of navigation, the problem of flood control and the disposition of mine debris are all inseparably connected. These matters are in charge of the California Debris Commission." (Annual Report of the Chief Engineer — 1914)

Nowhere was this more true than upon the river system of California's Great Central Valley. Upward of 1,000,000 short tons of freight valued at $60,000,000 (1910 dollars) and 300,000 passengers were carried annually, during the first decade of the twentieth century, by vessels of all classes plying the Sacramento, San Joaquin, Mokelumne and Feather Rivers. The freight consisted principally of grain, mill stuffs, lumber, groceries, fruit, vegetables, and general merchandise. About 50 steamboats, and dozens of barges, launches and scow schooners were engaged in this river commerce. Moreover, the rivers provided, in many cases, the only means of transporting passengers and freight to and from points in the valley. Great tracts of the fertile country along the Sacramento and San Joaquin were not served by railroads because of the expense and difficulties of construction and maintenance in lowland regions which were subject to flooding almost every year.

The Corps of Engineers began making limited improvements to the Sacramento and San Joaquin as early as 1875. In the main this consisted of snag removal, survey work and, to a limited extent, some dredging to remove the accumulated muck that clogged the channels and hindered navigation. Wing dams made of brush were also placed in the rivers at right angles to the current so that they would concentrate the flow and help the natural action of the water to scour the bed. Then, in 1880 it will be remembered, Colonel Mendell was directed to make

> such examinations and surveys as may be necessary to devise a system of works to prevent the further injury to the navigable waters of California from the debris from the mines and the estimates of the cost of such works, and report the result of such examinations, surveys, and estimates of cost of proposed works made in pursuance hereof to Congress . . .
>
> (*Appendix MM, Report of the Chief of Engineers, U.S. Army for 1881*)

From 1875 to 1893 when the Debris Commission was formed, the Corps of Engineers carried out its duties under Congressional authorizations that were too modest to attack the problem with any real hope of rehabilitating the rivers. Even the Caminetti Act of 1893, while confirming in principle the will of Congress, didn't of itself immediately add funding to authority.

In 1899 a definitive project for improving the Sacramento River was funded, making it possible for substantial work to get under way for the improvement of navigation. The project, as authorized, provided for a channel with a seven-foot depth extending from the mouth of the river (Delta area) to the City of Sacramento. From Sacramento upstream to the farming community and river port of Colusa, the channel was to be a minimum of four feet deep at low water, and three feet from Colusa to Chico. Finally the engineers were to maintain "depths as practical to Red Bluff," considered the head of navigation on the Sacramento.

The period 1890-1903 was the time of extensive wing dam construction, particularly in the area of the City of Sacramento. During these same years the snag boat **Seizer** and its crew pulled thousands of snags from the rivers, allowing the flood waters to course more easily through the channel. Debris Commission employees also cut overhanging trees that were dangerous to steamboats and their passengers. In 1908 the **Seizer** was joined by a new snag boat, the **Tackle,** built expressly for working the area between Colusa and Red Bluff. Built of Oregon fir, the **Tackle** was 64 feet long, 28 feet wide, and drew only 3½ feet of water. Such a vessel was ideally suited for working in shallow depths.

The situation on the San Joaquin River was quite similar to that on the Sacramento. Even though the amount of mining debris that was carried in its tributaries was not as substantial as those of the Sacramento, when added to the detritus caused by natural erosion, the problems were just as serious. During the last quarter of the 19th century only shallow-draft steamboats and sailing vessels could operate on the upper reaches of the San Joaquin because of the river's poor condition. Before improvement, the main channel below the City of Stockton was extremely crooked and difficult to navigate. Above the city, the river was obstructed by numerous snags and sand bars. Beginning in 1874, surveys, plans and appropriations were made for the improvement of navigation throughout the Stockton region. By the turn of the century, Stockton had, like Sacramento, become the practical head of navigation and the center for commercial activity.

By 1907 extensive surveys had been completed by the Corps of Engineers — the Debris Commission since 1893. It became obvious that the entire system must be thought of and developed as a single unit if complete protection and full utilization were to be achieved. Careful planning on a large scale was essential if permanent and meaningful navigation, flood control and debris projects were going to be completed in a timely manner. A.D. Foote,

in his monograph entitled *The Redemption of the Great Valley of California*, summarized the situation when he stated,

> . . . the work done for navigation alone is fatal to flood protection because it contracts the drainage channels in order to give depth at low water, and thus prevents the free passage of the floods. Works for irrigation alone take water needed for navigation. Mining is stopped because the debris fills the drainage channels and spreads over the farmlands. Drainage is blocked by the levee system built for flood protection; and to build levees for flood protection alone is hopeless . . . Fifty years of mishandling natural riches and spurning natural laws have so far injured it that now it may be said, in an economical or engineering sense, the Great Valley is lost to the world.
>
> (Foote, A.D. "The Redemption of the Great Valley of California." Reprinted in *Proceedings*, American Society of Civil Engineers, Sept. 1909)

While Mr. Foote may have exaggerated when he said that the valley was lost to the world, he nonetheless understood the overall implications of ignoring so powerful a natural force as a great river system. Interestingly enough, he delivered his views during the same year that the valley suffered even greater flooding than usual. Hardly had the residents recovered from the massive destruction visited upon them in 1907 when torrential rains forced the rivers over their banks in 1909. Both the 1907 and 1909 floods were near record events for the valley, and in many instances were comparable to (in places surpassed) the legendary flood of 1862.

Levee construction during the early days, within the Sacramento District, meant long days and a lot of mule power. (National Archives Photos)

Following years of study, the California Debris Commission submitted its views to Congress in June, 1907, relative to a comprehensive plan for river rehabilitation and development. The final plan, known as the "Jackson Report,"* was sent to Congress in 1910, and provided for a comprehensive plan to improve navigation and flood control on the rivers. Specifically included in the proposal were: (1) the construction and enlargement of levees along the river banks; (2) the construction of levees to create artificial channels called "bypasses" that would conduct the flood water in excess of the river's capacity; (3) the construction of weirs to discharge flood waters from the river into the bypasses; and (4) the enlargement, by dredging, of the channel of the Sacramento from Cache Slough to Suisun Bay.**

The Jackson Report represented the culminating effort relative to studies, surveys and plans put forth to improve navigation and control flooding of the Sacramento River. Several of the earlier proposals contained sound reasoning and each was reexamined during the formulation of the Jackson Report. One of the first plans devised to solve the problem was drawn by a board of consulting engineers consisting of General B.S. Alexander and Colonal George H. Mendell, Corps of Engineers, and a Mr. J.B. Eads.

Prepared by General Alexander and subscribed to by the others, the plan called for confining the river between high levees and was intended eventually to carry the entire flow of the river. Side relief channels were to be constructed to accommodate the excess water not carried by the river itself. These channels were to be ultimately abandoned when the river had developed the ability to scour its bed

* Captain Thomas H. Jackson was District Engineer at the time.

** Printed in House Document No. 81, Sixty-second Congress, first session.

and thus carry the entire flood flows. This plan was never accepted by the California State Legislature for whom it was prepared and was eventually disregarded.

In 1904 a project was prepared by a board of engineers consisting of T.G. Dabney, state levee engineer, Mississippi; Henry B. Richardson, member of the Mississippi River Commission; M.A. Nurse, chief engineer, State of California, Commission of Public Works; and Major H.M. Chittenden, Corps of Engineers. This project, known as the Dabney Report, was similar to that prepared by General Alexander, and contemplated confining the entire flow at high stages between permanent levees. Moreover, the use of side relief channels was counted upon until the project was far enough advanced to rely on the improved channel. Cutoffs were also planned with a view to reducing the length of the river and increasing the slope. One third of the anticipated excavation (about 120,000,000 cubic yards) was to be done by dredging or other mechanical means, while the balance (about 240,000,000 cubic yards) was to be made by natural scour.

The Dabney project was predicated upon a maximum flood discharge of 250,000 cubic feet per second below Cache Slough, an amount greater than that provided for by any previous project. The estimated cost of this work was $23,776,000.

The principal objections to the Dabney plan were:

1. The plan was based upon a maximum flood discharge of 250,000 cubic feet per second (measured at Collinsville). Records of the United States Geological Survey on the floods of March, 1907, and January, 1909, showed that it would be unsafe to provide for less than 600,000 cubic feet per second. This meant that channel capacities below the mouth of the Feather River would necessarily have to be more than double the size of those called for in the Dabney Report.
2. The Dabney project provided for the moving of about 320,000,000 cubic yards of material, of which about 214,000,000 were to be removed by the river (scour) and carried to tidal waters. If the project were modified to meet the known maximum flood discharge, it would mean the displacement of some 545,000,000 cubic yards of material. Such an amount simply could not be washed into Suisun Bay without causing serious injury to that body of water. The filling of Suisun Bay would also result in the raising of the flood plain at the mouth of the Sacramento River with a consequent raising of the flood plain at points upriver.
3. To insure that the main channel could handle maximum flood flows, the channel itself would have to be excessively wide. This would generate a pair of negative aspects: (a) the low-water navigation channel would be ruined and (b) the river would be unable to carry the debris (natural and man-made erosion) brought into it by the floods. The Debris Commission likened the probable situation to that of the Feather River below Marysville where the channel, having become filled with debris, had such a great width that the flow at mean and low water stages was not sufficient to carry in suspension the debris brought into it from the Yuba and Bear Rivers during flood times.
4. Finally, the CDC saw two other problems with the Dabney Report. On the one hand no specific time line could be projected for the scouring action of the river. On the other, if the project was modified to satisfy known discharges, the cost of a "main channel" system would be in excess of $90,000,000. The Debris Commission could not justify such a vast sum.

The Commission sought a plan whereby the Sacramento River could be brought under control and navigation enhanced. They also wanted the final project to be economically feasible and have a definite completion schedule. They turned their eyes away from a "main channel" concept and toward a "bypass system." One that contained many favorable elements was that proposed by a group of consulting engineers (Marsden, Manson and Grunsky) and presented to the California Commissioner of Public Works in 1894. The main elements of that project included:

1. enlargement of existing channels to provide maximum capacity as drainways, i.e. channel rectification;
2. overflow of surplus water from the river channel at selected points;
3. control of the surplus water between embankments forming bypass channels, and a rapid delivery system of same into Suisun Bay.

Building upon their own studies and surveys and those completed by others such as Dabney and Marsden, the Debris Commission drew up a specific, comprehensive and cost-effective plan and submitted it to Congress. In the minds of the Commission members it seemed . . "practical to control the floods in this river and its tributaries in such a manner as to secure the desired results, without the objectionable features of injury to Suisun Bay, injury to navigation in the Sacramento River, from Cache Slough to Colusa, indefinite period of construction, and excessive cost." (Jackson Report)

The Jackson Report incorporated ten specific steps that, when completed, would greatly improve navigation and reduce the devastation caused by the flooding Sacramento River. They were:

(a) Dredging to flood channel section that portion of the river below Cache Slough, with rectification of the channel by a cut-off at Horseshoe Bend.
(b) Improving the channel at various points, especially at the head of Steamboat Slough, so that the river from Cache Slough to American River will have a capacity of about 100,000 cubic feet per second.
(c) Constructing a weir (Fremont Weir) opposite the mouth of Feather River and connecting it by means of a permanent bypass in Yolo Basin with Cache Slough, this bypass and weir to be of sufficient cross section to carry all flood waters that cannot be carried by the present river below the above weir.
(d) Constructing a weir (Moulton Weir) at Moultons Break, about 13 miles above Colusa, and connecting it by means of a permanent bypass in the Sutter and Butte basins with the Sacramento River at its junction with Feather River, this weir and bypass to be of sufficient capacity to carry all flood waters that cannot be carried by the present river.
(e) Increasing the cross section of the river above Moultons Break by raising the levees and placing them further apart, so that the increased cross section will provide for the estimated discharge.

(f) Constructing a weir (Sacramento Weir) at Bryte Bend, 2 miles above the mouth of the American River, and connecting it by means of a permanent bypass with the Yolo Basin bypass, this bypass and weir to have a capacity of about 70,000 cubic feet per second or sufficient to carry the excess flood water that reaches that point.
(g) Reconstructing the Tisdale* Weir (located 26 miles below Colusa) and connecting it by means of a permanent bypass with the Sutter-Butte Bypass, the weir and bypass to have a capacity of about 35,000 cubic feet per second or sufficient to carry the excess water that reaches that point.
(h) Confining to their present channels by means of levees the flood waters of all the important tributary streams.
(i) Collecting the hill drainage in intercepting canals and conveying it to the rivers or bypases at convenient points.
(j) Providing for the drainage of the basins by placing culverts with gates at various points in the bypass levees.
(Jackson Report)

The Commission, while pointing out that a variety of questions would need to be answered prior to implementing its proposal, was quick to list the advantages of a bypass system. The Commission believed that the project could be completed for about $33,000,000, or about 35 percent of the cost of a main channel project of equal capacity. Moreover, the cost of maintaining the river channels, both from a standpoint of navigation and flood control, would be less than the maintenance of equally good channels under a main channel project. Of significant importance to the Commission, no injury would be done to Suisun Bay by the scouring of hundreds of millions of yards of material into it. In addition, the period of construction would be less. Finally, the Commission saw a bypass system as especially adaptable to a series of storage reservoirs should such reservoirs ever be constructed.

The California Debris Commission was particularly forward-looking by suggesting that a plan to control the Sacramento River be thought of in terms of coordination with storage reservoirs for flood control. Such reservoirs were years away conceptually for many water resource planners. For the CDC, however, the use of reservoirs for flood control seemed to have real merit, especially when tied to a comprehensive plan to reclaim the Sacramento River.

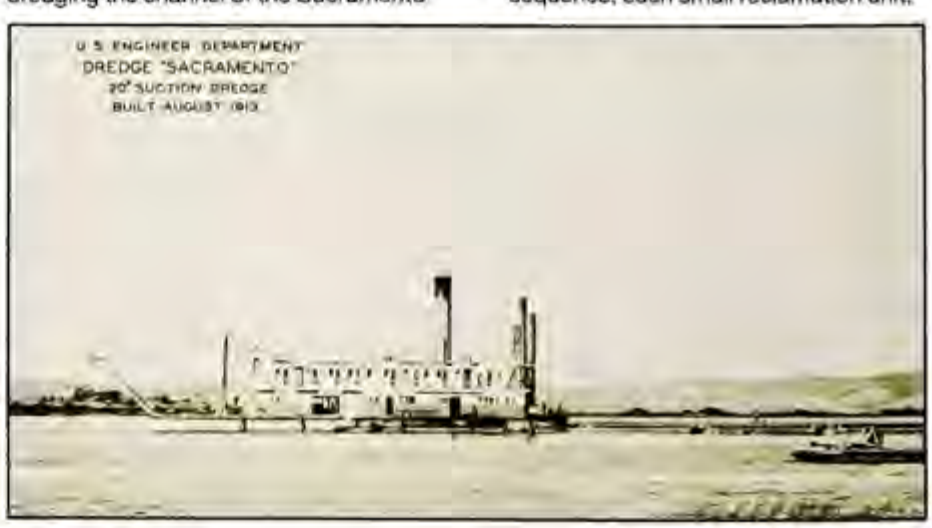
The California Debris Commission made examinations and surveys of reservoir sites in both the Coast Range and the Sierra.** Finalization of the Jackson Report was in fact delayed until the examinations could be carried out. The CDC felt that reservoir capacity in the Coast Range was relatively small. In the Sierra the Commission afforded particular attention to three possible sites: Indian Creek in Plumas County, Pit River in Northern California and on the North Fork of the Feather River.

Following its surveys, the Commission concluded that building reservoirs at that time strictly for flood control was not economically sound. "While favoring the use of reservoirs as far as possible, and considering that one of the advantages of the project herein proposed is that it lends itself to future storage possibilities, the Commission believes that it is not economical to construct reservoirs for flood control, but that such construction should be deferred until these reservoirs prove desirable for power and irrigation purposes." (Jackson Report)

Congress, while favorable, once again supported the principle but did not fund the entire plan. Instead it approved the so-called "minor project" which provided for dredging the channel of the Sacramento River in the area downstream from its junction with Cache Slough. The State of California also appreciated the need for a coordinated effort relative to river and flood control work. Having worked closely with the Debris Commission since its formation, its officials held the Commission and its plans in high regard. So when the "Jackson Report" of 1910 was accepted at the national level, the state adopted it as well. From that point on the report became the very foundation for all subsequent work on the Sacramento River. At about the same time, the State of California created the Reclamation Board, which had the power to require all future plans of reclamation to conform to the "Jackson Report" — with such modifications as it deemed prudent.

Prior to the formation of the Reclamation Board, it was generally believed that an individual owner had as much right as the next to reclaim his land in whatever fashion he deemed appropriate. The report of the Board in 1912 reviewed pre-existing conditions.

> Under the conditions obtaining up to the date of passage of this act owners of property anywhere in the basin were at liberty to reclaim practically as they pleased, with various boards of supervisors, acting independently of each other, might see fit to impose. Such restrictions rarely considered the interests of any save immediate neighbors. In consequence, each small reclamation unit,



* The Tisdale Weir was originally constructed by the State of California.

** The Geological Survey and the Reclamation Service had completed similar studies.

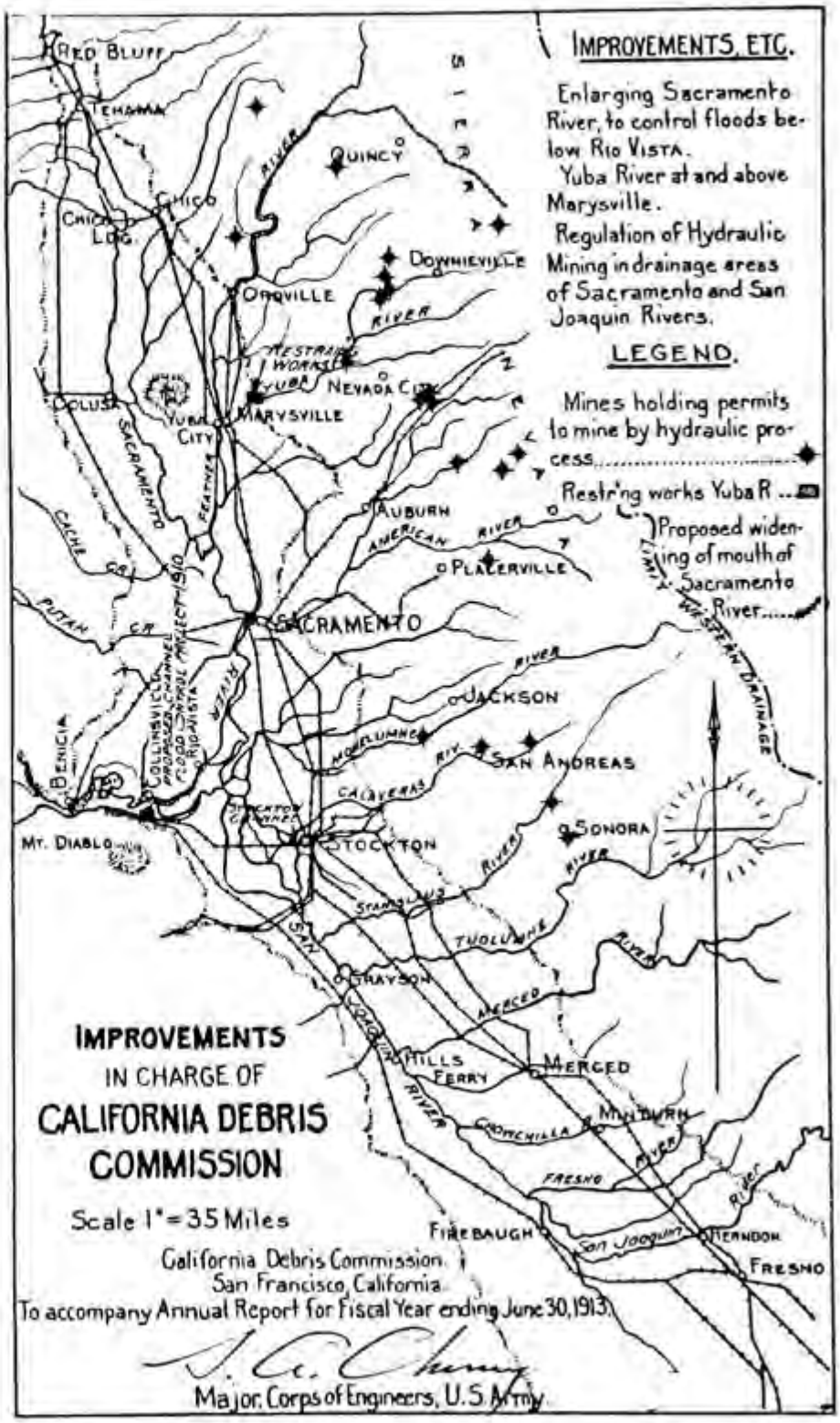
instead of acting along a general plan which would secure safety for all, was intent only on saving itself. It really levied **against** its own neighbors, and looked for its own safety through their destruction. The flood plain steadily rose because increased reclamation confined the waters more to the river channels, and there were no bypasses to rapidly carry off floods and no width of channel at the rivers mouth sufficient to discharge them. Levees steadily increased in height, adding additional burden to the land. The inevitable end, with a river channel at and below Sacramento City with a capacity of but 100,000 second feet, and record floods of 1907, which, if in crest at the same time, would have sent 600,000 second feet down to tide water, must be annual destruction or over-topping of levees with enormous consequent damage, and perpetual danger for all interests in the valley. No possible levees could prevent this result.

(Quoted in *Commitment to Excellence* — A History of the Sacramento District, U.S. Army Corps of Engineers)

Funding to implement the "Jackson Report" was shared equally by the federal government and the State of California. The Debris Commission estimated that it would require an initial outlay of some $800,000 to complete the work. In submitting this estimate to Congress, the Commission expressed the opinion that one-half should be provided by the State of California. Perceiving this as a fair proposition, the state, on March 1, 1909, appropriated $400,000 for the river project. To insure that the Commission lived up to its part of the bargain, the appropriation bill contained language that stipulated:

> This act shall become operative only upon condition that the Government of the United States shall . . . assume full charge and control of all work . . . and also upon condition that a like sum of four hundred thousand dollars be appropriated by the United States . . .
>
> The . . . amounts appropriated (by Congress and the State) shall be expended under . . . the supervision of the Chief of Engineers.

(Quoted in Annual Report of the Chief of Engineers — Appendix ZZ — 1914)



Subsequently the River and Harbor Act of 1910 appropriated the federal portion. Then, in compliance with the requirements of the act of Congress, the State of California deposited the state's share in the Treasury of the United States on July 11, 1911. Furthermore, local interests furnished the United States, free of charge, all rights of way for levees and spoil banks needed in carrying on operations.

The first work completed under this comprehensive project consisted of the construction and operation of a pair of large suction dredges — the **Sacramento** and the **San Joaquin**. These were completed in 1913 and put to work dredging in the channel of the Sacramento River near Collinsville.* By the summer of 1914 almost three and a half million cubic yards of material had been removed from the flood channel. Of the material excavated, more than a million and a half yards was used in the construction of levees on Sherman Island.

During this same period local interests expanded their work to a significant degree. This was due in large measure to the fact there was now a definitive plan (Jackson Report) accepted by all concerned for the rehabilitation of the rivers. The Commission's 1910 report ushered in a period of tremendous development in the Sacramento Valley in the way of extensions of old, and construction of new, steam and electric railroads. In addition, old levees were strengthened to protect lands already reclaimed, and new levees built to reclaim still more agricultural land. In fact, by the summer of 1914 the Debris Commission discovered that much of the work it had planned had been completed by private interests, thus saving the government huge sums of money.

By the close of 1916 the Commission's plan was well on its way. In the Yolo Basin, east of Sacramento, some two dozen miles of the east levee had been constructed, and many more miles planned and approved. When completed, more than 40 miles of levee would form the entire east levee of the Yolo Bypass. Several miles of the Sutter Basin bypass levees had also been completed. New levee districts were being formed and legislation passed to supply the funds necessary to keep the work going. The City of Sacramento voted bonds for the construction of the Sacramento Weir to carry the floods of the Sacramento and American Rivers to the Yolo Bypass. The Sacramento Weir, built by the city, was completed in 1918.

Meanwhile, work on the Sacramento River continued under the supervision of the Debris Commission. Up to June 30, 1916, almost 17 million cubic yards of material had been dredged from the Sacramento River. From the town of Rio Vista to Three-mile Slough the channel had been enlarged by an average width of 320 feet and a depth of 27 feet for a distance of some three miles, and the old levee on the north side of the river removed. From Three-mile Slough to Bakers Point excavations 250 feet in width, 27 feet in depth and 9,400 feet long had been made across the "horseshoe" and the levee on the rim at Bakers Point breached. Above Collinsville the channel had been enlarged by an average width of 100 feet and a depth of 27 feet for a distance of 4,800 feet; the north side of the channel was excavated to a depth of 27 feet and a width of 250 feet for a distance of two and three-quarters miles. Old levees on the north and south sides of the channel had been breached, and 2,800,000 cubic yards of material removed and placed on Sherman Island. Expenditures to that time totaled $1,100,500 for new work (none for maintenance). Of that sum the state and the federal government contributed just about the same amounts.**

The Debris Commission continued to study the overall plans for river reclamation even as it worked under the 1910 authorization. In 1915 the Commission submitted a revised comprehensive plan "for the relief from floods to the Sacramento Valley and adjacent San Joaquin Valley." The new plan, if carried out, was estimated to cost $33,000,000, one-third to be paid by the federal government and two-thirds by the State of California.

In the spring of 1917 Congress passed truly benchmark legislation when it adopted the Debris Commission's general plan for flood control of the Central Valley. From that point on flood control, as a separate consideration from navigation, was added to the other federal activities on the Sacramento and San Joaquin Rivers. The Flood Control Act of 1917 marked the first time that Congress extended the federal flood control policy of the Corps of Engineers from the Mississippi Valley. Moreover, it affirmed the policy of local cooperation by providing that local interests should contribute substantially to construction costs. Further, the act authorized river surveys to be completed with a view toward flood control while at the same time requiring that all other water uses be considered as well.

The 1917 act was based upon the 1910 "Jackson Report" as modified by subsequent legislation. It also stated that "all the work is to be done under the direction of the California Debris Commission upon cooperative requirements . . . (and) upon completion, all the works for flood control are to be turned over to the State of California for maintenance." Up to that time levee construction per se was an obligation of the state and local interests. The 1917 act did not change this part of the law, but only held that the federal government would cooperate more fully in such construction. Finally, it is worth noting that much of the levee construction work, prosecuted with considerable vigor during the years 1917 and 1918, was done to reclaim as much land as possible so as to increase food production in support of our war effort.

During the years following World War I, farmers decried the burdensome costs associated with levee construction. Some farmers did in fact go bankrupt. The reasons for their economic failures cannot be blamed entirely upon levee construction costs, but such expenditures did add materially to their overall difficulties.

On May 1, 1924, the U.S. Senate's Committee on Commerce passed a resolution stating:

> That the Board of Engineers for Rivers and Harbors, created under section 3 of

* Dredging operations were begun in the Sacramento River a short distance from Collinsville in August 1913 with suction dredges **San Joaquin** and **Sacramento**, each with a crew of approximately 40 men. The dredges and auxiliary plant cost $444,156 to build.

** The Debris Commission's work had been prosecuted with such enthusiasm that the Anti-Debris Association disbanded in 1915.

the river and harbor act approved June 13, 1902, be, and hereby is requested to review the reports on the control of floods in the river system of the Sacramento and San Joaquin Valleys, California . . with a view to determining whether any modification in the existing (1910) project is advisable at the present time.

(Senate Document No. 23, Sixty-ninth Congress, First Session a.k.a. "Grant Report")

Chief of Engineers, Major General Taylor, subsequently ordered the California Debris Commission to conduct a review of its 1910 project in accordance with the Senate resolution. The Commission, then consisting of Colonel Herbert Deakyne, Major U.S. Grant, 3rd, and Major H.A. Finch, immediately set forth to reexamine the project in light of new knowledge and the conditions as they existed during the early 1920s. On January 5, 1925, the CDC submitted a modified plan, known thereafter as the "Grant Report," to the Chief of Engineers. Specific modifications to the Sacramento River work previously recommended included:

1. Elimination of reclamation works in Butte Basin.
2. Elimination of Moulton Weir and construction of a less expensive weir at Moulton Break.
3. Construction of a weir above Colusa.
4. Elimination of two of the four proposed cutoffs in the stretch of river between Colusa and the mouth of the Feather River.
5. Utilization of the existing Tisdale Weir instead of building a new one.
6. Relocation of certain levee lines on the Feather River and Yolo Bypass.
7. A settling basin at the mouth of Cache Creek.
8. Three sloughs in the delta to be left open instead of closed.
9. Increase in levee cross section(s).

During the course of the reexamination, the Commission arrived at some very important conclusions relative to the existing relationships among the federal government, the State of California and the private sector. Based upon the new information gathered during the first half of the 1920s, the Commission concluded that the federal government had a **direct interest** in the completion of the flood control and navigation work then being prosecuted in the Sacramento Valley. Additionally, the CDC felt that the landowners were having to pay significantly greater amounts of money for the flood control (levees) projects than had originally been projected. The cause for this was laid to the special conditions arising out of the war and to the natural increase (inflation) in the cost of the project during the 15 years that elapsed since the first estimates were prepared. Finally the Commission held that the suggested modifications would reduce the overall costs of the work.

These conclusions became the foundation upon which the Debris Commission

Wire basket cobble-filled dam in Scotchman Creek for restraining tailings resulting from hydraulic mining at Omega Mine near Washington, Nevada County, Calif.

View taken April 10, 1919, after failure of above dam.

When the Omega Dam burst in 1919, debris was released into the rivers. (Corps of Engineers' photos)

proffered sweeping, if not organic, changes in federal-state relations. The Commission recommended that the United States assume responsibility for the execution of and pay for all work of enlargement and rectification of the river channels and the construction of weirs, including future purchases of land and easements for spoil areas. A second recommendation was for the United States to contribute one-half the cost (previously only a third) of construction of levees. This, it was believed, would greatly lessen the burden of the local landowner.

To pay for the increased federal participation, the CDC recommended that the limit set on the contribution of the United States by the 1917 Flood Control Act be increased from $5,600,000 to $17,700,000. The Commission also wanted the annual appropriations raised from $500,000 to $1,000,000 so that the work could be completed in a reasonable time.

Yet another recommendation of the Commission was for the federal government to return to the State of California the amount which had been expended on the project by the CDC from funds contributed by the state to that time. Finally, the Commission suggested that the United States should do whatever work was necessary to maintain the increased capacity of the channels of the rivers, sloughs and other waterways, including protection of their banks, and to insure the preservation of the weir structures in effective conditions.

It must be noted at this point that while the California Debris Commission was charged with correcting debris damage, improving navigation and maturing plans for flood control on both the Sacramento and San Joaquin Rivers, actual work was limited to the Sacramento River. Initially this was so because the Sacramento was most seriously affected by mining debris. Thus, CDC efforts were concentrated on the most urgent problem area. Later, the Commission came to hold the belief that, even though the Congressional resolution requested a review of the San Joaquin River, " . . . flood control of this area (San Joaquin River) is not affected by the project under discussion, except for incidental drainage, and that the flood problem of the San Joaquin should be made the subject of a separate report, if conditions in the future require it."

Up to the period of the mid-1920s, the CDC had conducted various studies and surveys of the San Joaquin and its major tributary streams and had drafted "considerations" relative to that area. After completing the Grant Report, however, the Commission stated definitively that the San Joaquin was, and should be, a separate issue.

In reality, the Corps of Engineers, through the offices of the Second San Francisco District, had been making improvements to the San Joaquin River since the turn of the century. It appeared to the Debris Commission that this was as it should be, and apparently the Commission didn't care to extend itself further.

The River and Harbor Act of May 15, 1928, adopted the CDC recommendations put forward in the Grant Report of 1925. From this point forward, the federal government, through the California Debris Commission, and later through regular Corps of Engineers Districts, would invest millions of dollars in levees, weirs and other flood control projects throughout the Valley. Typical of such construction was Fremont Weir, completed by the Commission in 1924.

All did not go as smoothly as it might have, however, in either the construction or the political area. For levee building, especially in the delta region of the Sacramento and San Joaquin Rivers, was (and remains) quite difficult because of the unstable conditions of the peat soil used in construction. Often the sheer weight of a levee would cause the area on which it rested to sink, causing a bulging up in an adjoining area. At other times the soft earth would topple into the water soon after being placed upon the banks. Wave action, caused by violent winds, high tides and powerboats, undercut levees, causing them to give way, resulting in large tracts being inundated. Over the years losses have been tremendous, and in one case, an entire island (Franks Tract) was lost forever. On still other occasions the peat soil, of which the majority of delta levees were constructed, became water-logged and gave way with disastrous consequences.

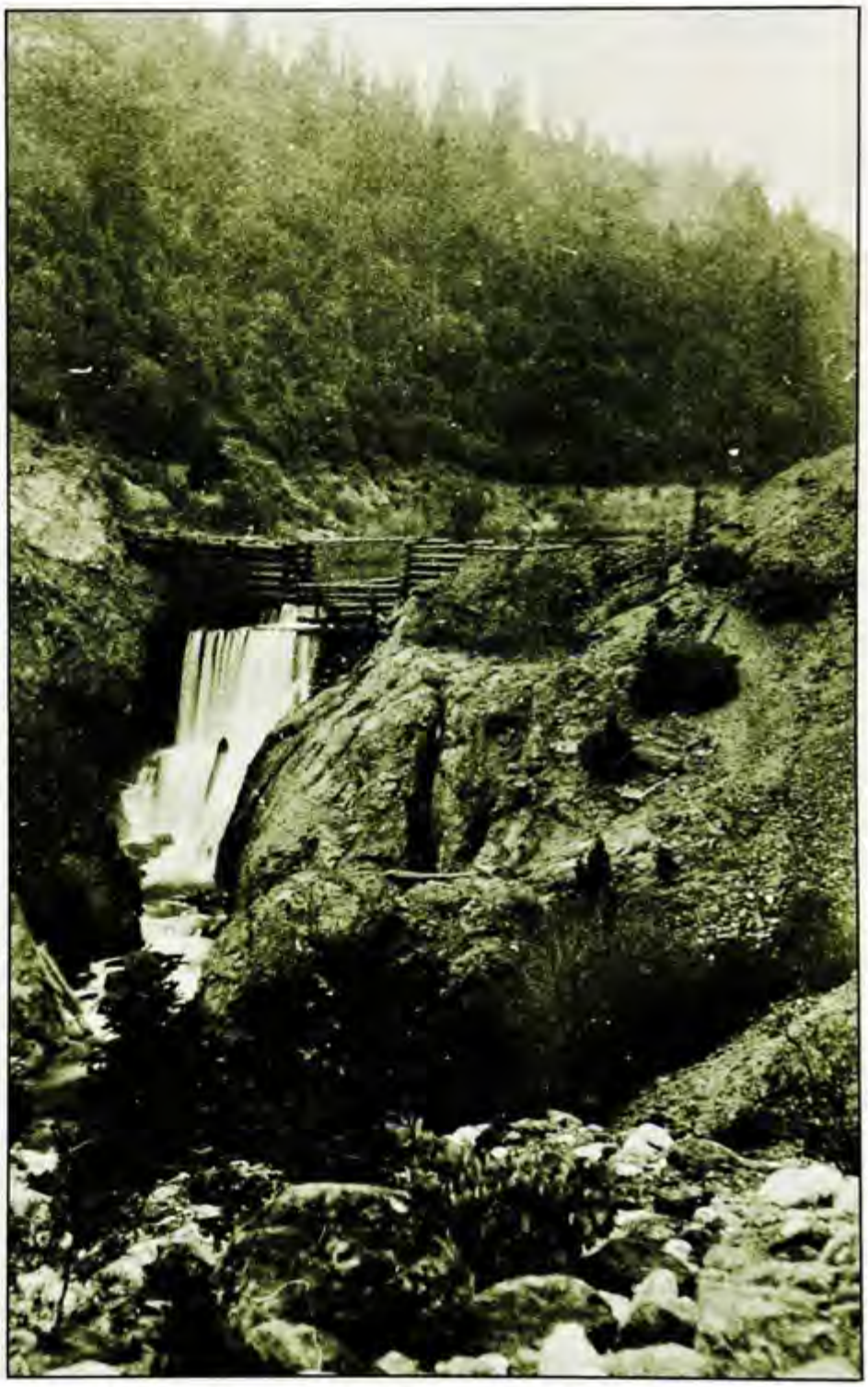
Politically, the Grant report was the focus of considerable controversy. A local congressman, Charles Curry, wanted the bulk of the work outlined in the Grant Report to be carried out under the authority of the California Debris Commission. On the other hand the Office of the Chief of Engineers (OCE) wanted the work assigned to, and prosecuted by, regular District organizations. At the time, the entire Sacramento and San Joaquin River system was part of the Second San Francisco District, with headquarters in San Francisco. For practical purposes, however, a sub-office was established in Sacramento in 1914 to oversee the actual work. After considerable muscle-flexing by both parties, the Chief of Engineers was overridden, and the work outlined in the report — at least initially — was done by the California Debris Commission. In the final analysis, however, the disagreement led to the effective end of comprehensive river work by the Debris Commission. From the early 1920s, the work of the CDC was blended with that of the Second San Francisco District engineer organization until the two were indistinguishable. It is probable as well that the extensive nature of the work involved simply exceeded the resources and organizational structure of the Commission. One notes that language in the Annual Reports of the Chief of Engineers during these years suggests that, "Administrative work to a certain degree overlaps and has to be conducted with that of improvements (on the Yuba, Sacramento and San Joaquin Rivers) and that of the Second San Francisco District."

In March 1925, the Corps of Engineers and the Federal Power Commission (FPC) were directed by Congress to prepare and submit cost estimates for surveys of navigable streams where it was feasible to develop hydroelectric power in conjunction with improvements for navigation, flood control and irrigation. In April of the following year, Major General Taylor, Chief of Engineers, and O.C. Merrill of the FPC sent to Congress, through the Secretary of War, documents outlining all navigable streams of the nation whereupon power development seemed feasible. The Sacramento and San Joaquin were among those listed. House Document 308, as the report became known, launched and guided the most extensive study of the nation's and California's water resources undertaken to that time. The following year the extensive River and Harbor Act of 1927 charged the Corps of Engineers with the responsibility of completing the surveys recommended in House Document 308.

For the first time in history the streams of the entire nation would be inventoried with a view toward integrated development. The impact upon the Second San Francisco District was enormous. A great variety of projects were subsequently authorized for the improvement of the Sacramento and San Joaquin Rivers and their tributaries. The vast amount of new work pointed to the need to create a separate engineer district to complete the authorized projects. During the summer of 1929, Lieutenant Colonel T.H. Emerson, who was secretary of the Debris Commission and a ranking officer of the Second San Francisco District, became the first District Engineer of the Sacramento District, U.S. Army Corps of Engineers. The officers who served as secretaries of the Commission had traditionally been charged with immediate supervision of the work accomplished under CDC authority. Since 1929, the District Engineers of the Sacramento District have continued to serve as secretaries of the Commission. The Presidents of the Commission have come from the ranks of the Division Engineers of the South Pacific Division while the third members have usually been District Engineers from the San Francisco District.

Blending, overlapping and synthesis of project work notwithstanding,the California Debris Commission continued to report its activities as a separate body. By 1935 the Yuba River project (with the exception of maintenance) was virtually complete, and work was progressing well on the vast Sacramento flood control and navigation project. Overall, the work was considered to be 76 percent complete by the mid-1930s.

During 1935 alone, government dredges (**Sacramento** and **San Joaquin**) and hired labor removed 2,269,300 cubic yards of material from the Sacramento River and delta channels. During that same year, crews seeded spoil areas with grass, cleaned ditches and placed tons of riprap on the sides of the channels to protect them from wave action. In addition, levees were built, brush and snags were cleared from the river — especially in and about the weirs — and surveys undertaken to monitor the overall conditions of the project. A flow chart of the Debris Commission's work on the Sacramento River to 1935 would show that cut-offs at Collins Eddy and between Wild Irishman and



While the CDC prosecuted work on the Sacramento River, mines such as the Liberty Hill continued limited operations — 1926. (Corps of Engineers' photo)

Snag crews work to clear trees from the banks of the Sacramento River.

Men worked hard and long during the thirties to reinforce levees along the Sacramento and San Joaquin Rivers. (Corps of Engineers' photos)

Kinneys Bends were made in 1918 and 1919, respectively. Sacramento Weir was completed in 1917, Fremont Weir in 1924, Tisdale and Moulton Weirs in 1932, and Colusa Weir in 1933. Outfall gates at Knights Landing were constructed in 1930. The outfall gates at the mouth of Butte Slough were under construction.

During this same period — the mid-Depression years — the California Debris Commission and its president, Colonel Thomas H. Jackson, came under attack by the very people the work was designed to benefit most.

Colonel Jackson, it will be remembered, had been active in flood control work in California since his first assignment to the California Debris Commission in 1907. It was then, as a captain, that he played a significant role in designing the multi-million dollar Sacramento Flood Control Project. During World War I Jackson was given command of the advanced section of the Corps of Engineers on the famous "Western Front." The same bold imagination and the qualities of leadership that stood him in good stead during his tour of duty with the CDC were used to good purpose during the war. For his dedicated and excellent service, Jackson received the Distinguished Service Medal, the Purple Heart, Officer of the Legion of Honor (France), Commander of Leopold (Belgium), and the Polish Order of the Valiant.

Upon returning home to San Francisco in 1922, he served as Sixth Corps Area Engineer for six years. In 1928 he was appointed president of the Mississippi River Commission with the rank of brigadier general. On August 21, 1934, Jackson was made Division Engineer of the South Pacific Division, and at the same time received a presidential appointment to serve as president of the California Debris Commission.

Colonel Jackson set about to review the progress of the work that he helped put in motion almost three decades earlier. After studying the situation, he felt that a bit of fine tuning was necessary to make the entire system of channels, levees and weirs achieve its maximum potential. He subsequently proposed some modest changes. A specific modification — the setting back of new levees further away from the river channel — caused deep concern among local valley residents. When he later called a temporary halt to some of the work to allow new plans to be drawn, Jackson incurred the wrath of Sacramento's newspapers. Their attack upon him and the Commission was unremitting, protracted and envenomed. When Jackson demanded that a meeting with the State Reclamation Board be closed to the public, the *Sacramento Bee* charged that, "Such tactics on his part can be interpreted by the public in only one way . . . he is

Colonel Thomas H. Jackson. Photo taken when Jackson was a Captain. (Corps of Engineers' photo)

afraid to let the spotlight of public analysis shine on his proposed changes." (*Sacramento Bee* August, 1935 - July, 1936)

In another article the local people were reminded that "Sacramento, through the late Congressman Curry, had its flood control program adopted by Congress and the army engineers were detailed to help carry it out. Everything has proceeded smoothly until Colonel Jackson was placed in charge . . ." The *Bee* went on to warn the populace that "The lives and property of valley residents are at stake where floods are concerned. Colonel Jackson and no one else must be permitted to interfere with the levee protection afforded the city and lower valley." The *Bee* conceded the point that ". . . his engineering ideas may be sound and should have been included in the project originally," but argued, ". . . this is no time, with the work almost completed, to impose new and costly burdens on the landowners." In the same article it was threatened "If Jackson persists in his arbitrary attitude, the Reclamation Board has no alternative but to go over his head and seek relief from his superiors in Washington."

The attack upon Colonel Jackson continued unabated. Soon his detractors carried out their threats and contacted General E.B. Markham, Chief of Engineers. Early in October, 1935, General Markham came to San Francisco to effect a compromise between Jackson and his leading opponent, the State Reclamation Board. Chief Engineer for the Board, A.M. Barton, and State Engineer Edward Hyatt, presented engineering objections to Jackson's proposals during a half-day meeting with the Chief of Engineers. All the while A.R. Gallaway, president of the Reclamation Board, complained that Jackson's plan could not be financed by the state or the local landowners.

Following the hearing, General Markham ordered that briefs of the controversy be prepared and exchanged between the Debris Commission and the Reclamation Board. Moreover, Markham wanted a detailed summation submitted to his office. The general stated that he would have members of his staff arbitrate the matter if a mutually acceptable compromise couldn't be reached.

Shortly after Thanksgiving Day 1935, General Markham sent Brigadier General George B. Pillsbury, Assistant Chief of

Engineers, to Sacramento for an on-the-spot evaluation of the matter. On the morning of December 3rd, General Pillsbury, in company with Colonel Jackson, Colonel L.B. Chambers, Sacramento District Engineer, Edward Hyatt, State Engineer and A.M. Barton of the State Reclamation Board, set out on an inspection tour of the levee system between Sacramento and Colusa. Pillsbury and company spent two days reviewing the condition of the levees — all the while listening to the opinions of his fellow travelers. On December 5, 1935, he ordered the resumption of levee work on the Sacramento River. Jackson's critics hailed the ruling as a major victory. As a parting shot, some state officials warned that if any of the levees were breached that winter, Jackson would have to be held accountable due to his stalling tactics.

While the *Bee* had directed its attack primarily upon Colonel Jackson's ideas, the *Sacramento Union* seemed to carry the fight into the realm of personal vendetta. During the spring of 1936 the following indictment appeared in the *Union*.

> Colonel Thomas H. Jackson's name is anathema to the valley . . . (he) is an irritant and an expense to the valley. Instead of having to pass matters over his veto, why not remove him? It would save time, expense and constant irritation.
>
> It looks as if his attitude is one of studied unfriendliness to this section. It would be stretching human credulity too far to ask anyone here to believe Colonel Jackson is sincere in opposing every proposal looking toward the development of the valley section.
>
> It is time for the people to speak up. Their interests have been trampled upon, their requests for federal help have been scorned by an army man who is a misfit in any system of civilian benefits contemplated by the government.

The *Union* went after the Debris Commission's president not only on the basis of his views regarding levee construction, but also because he would not put his stamp of approval on a project to create a deep-water channel from Suisun Bay to Sacramento. Such a project was initially proposed as early as 1916 by various local governmental agencies located in and about the Sacramento area. For almost two decades, plans regarding the deep-water channel were either ignored or viewed as not being cost effective. The harsh realities of the Great Depression no doubt played a large role in the resurrection of the dormant scheme. So once again the city fathers of Sacramento dusted off the deep-water project plans and petitioned the federal government to support the proposal. Despite the economic ills besetting the Sacramento Valley during the mid-1930s, Colonel Jackson could not recommend federal expenditures for the work. Given the commerce statistics available to him and the projected cost of completing a channel to transform Sacramento into a deep-water port, the cost-to-benefit ratio dictated a negative recommendation on the part of Jackson.

The rhetorical siege continued and lasted into the summer of 1936, until on July 20th of that year, Colonel Thomas H. Jackson requested retirement after serving his country for forty-one years. On September 1, 1936, he was replaced as both South Pacific Division Engineer and president of the California Debris Commission by Colonel John J. Kingman. It is perhaps worthy of note that the Sacramento deep-water channel was finally authorized as a Corps of Engineers project in 1946, after immense pressure was brought to bear by local interests.

It is likewise worthy of note that the essential concepts put forth by Jackson relative to levee reconstruction and setback were adopted as part of the River and Harbor Act of August 26, 1937. Specifically, it stated that "the United States construct bank protection works and levee set-backs substantially as included in the 5-year program recommended by the California Debris Commission . . . and maintain the enlarged channel of the river below Cache Slough, including revetment of its banks . . ."

Excerpts from the Debris Commission's annual report for fiscal year 1940 reflect the amount of levee reconstruction and set-back work, as well as the typical flood control work accomplished by the CDC in the years just prior to the Second World War.

> As shore protection work, between the mouth of the river and Cache Slough, 5,900 tons of rock were placed on banks . . . and 39,991 cubic yards of material were removed from the flood channel and placed as reinforcement to shore protection . . .
>
> Preliminary surveys and preparation of plans for levee construction were made . . . Levees were constructed along flood channels, including installation of structures, closing of levee breaches and crevasses, clearing brush and removing snags, making test borings, work on plants for pumping drainage into Sutter Bypass, and incidental work on roads and irrigation facilities . . . Total yardage of this levee work was 1,841,783 cubic yards and total cost was . . . $479,381.26.
>
> The following work . . . was done by hired labor and Government plant . . . in bank protection and levee setback activities at various places on the main river between the mouth of Cache Slough (mile 15) and Butte City (mile 169): 50 acres were cleared; 1,279 snags were removed; 263,437 cubic yards were moved in grading banks; 5,338 squares of lumber mattress were laid; and 74,156 tons of rock were placed on banks and revetments; and 479,365 cubic yards of materials were placed in setting back levees. During the fiscal year a total of 18,985 linear feet of standard bank protection was completed . . . Total cost of new work was $1,056,728.70.
>
> (California Debris Commission Annual Report — 1940)

By the summer of 1940, the Sacramento River Flood Control Project, being prosecuted by the California Debris Commission, was considered to be 90 percent complete. Up to that time the total channel enlargement excavation amounted to more than 186,000,000 cubic yards. It was estimated that this work had produced a channel with a capacity of 570,000 second-feet below Cache Slough. In addition, some 25,000,000 cubic yards of material had been placed in levees along the project waterways.

On the eve of American involvement in World War II, the flood control project for the Sacramento River was once again modified. By the Flood Control Act of August 18, 1941, local interests were relieved of all future construction costs. At the same time, however, they were required to give assurances to the Secretary of War that they would provide free of cost

to the United States: (a) all needed lands, easements, and rights-of-way; (b) bear the expense of necessary highway, railroad, and bridge alterations; (c) hold the United States free from claims for damages resulting from construction of the works; and (d) maintain and operate all flood control works after completion.

When the nation entered the war, the flood control work, except for maintenance activities, of the California Debris Commission on the Sacramento River came to a virtual standstill. The vast resources of the Corps of Engineers were redirected away from civil works and focused upon the all-important task of providing support facilities for our armed forces. The officers of the Debris Commission, like those of the other components of the Corps of Engineers, quickly translated the skills employed in civil engineering projects to those required for airfield and training base construction. Thus literally no new work was completed upon civil works projects unless they related directly to the total war effort.

As the war began to wind down, many Americans began to concern themselves with providing employment for the thousands upon thousands of soldiers who would be returning to civilian life. Congress too shared such feelings and decided to take steps to ensure adequate employment for the returning veterans while at the same time bring to fruition projects that had been in the planning stages prior to the war. A few days before Christmas 1944, Congress passed the Flood Control Act of 1944 (Public Law 534, December 22, 1944, Seventy-eighth Congress, 2nd Session).

Not since the years of the Depression had a public works program of such vast proportions been authorized. The scope of the work projected was immense, and its impact upon the California Debris Commission lasting. Prior to the war, flood control plans were set down in terms of enlarged channels, higher levees, improved weirs and sizable bypasses. In the years following the war, the emphasis centered upon large multi-purpose projects that integrated huge storage reservoirs with extensive channel work.

Sacramento Weir in operation. The city of Sacramento is in the background (Corps of Engineers' photo)

The Flood Control Act of 1944 provided for the construction and enlargement of levees along the Sacramento and Feather Rivers in Butte Basin and in the Sutter and Yolo Bypasses, and for local improvements on nine minor tributaries of the Sacramento River. In addition the act called for the construction of Black Butte Dam on Stony Creek, located west of Orland in Glenn County, and for the construction of a dam and reservoir at Table Mountain in Tehama and Shasta Counties. The significance of all of this in terms of the California Debris Commission was that from 1945 on this project would be reported under the title "Sacramento River and Tributaries, California, from Collinsville to Shasta Dam" and further it would fall under the jurisdiction of the Sacramento District, Corps of Engineers. The blending and overlapping of functions had become complete. From the period 1945 to the present the flood control work on the Sacramento River has been handled through the regular organizational structure of the Corps of Engineers District of Sacramento.

The California Debris Commission can be proud of the extensive contributions made by it in helping complete one of the most important flood control projects in the United States. For by harnessing the powerful Sacramento, the Commission encouraged development of the Sacramento Valley on an unprecedented scale. That development in turn has contributed to the overall growth of the state and has enriched the lives of all who reside in the region.

Chapter VI

High Dams: The Last Hope

Even as the Debris Commission carried forward the debris control work on the Yuba River and the extensive flood control and navigation efforts on the Sacramento, it continued to monitor and regulate hydraulic mining. By the summer of 1929 the Commission had received a total of 1,008 applications for permits to mine by the hydraulic process. During fiscal 1929 only 29 miles were operating under the authority of the CDC — hardly the hoped for rebirth of the industry. But conditions were developing that would once again offer renewed hope for the proponents of hydraulicking. These conditions came to a head on October 29, 1929, the blackest day in stock market history, when over 16,000,000 shares changed hands. By mid-1932, 50 billion dollars had been lost and a significant part of the American work force was unemployed. Just as the "Panic of 1893" helped open the ears of Congress relative to the cries of the hydraulickers, the "Crash of '29" set in motion a depressed economic era that again gave support to long-standing arguments proffered by latter day miners for government aid to revive the industry.

Since the days of the Sawyer decision, and before, the miners held the belief that the construction of large dams would prove to be the ultimate answer for rehabilitation and maintenance of the hydraulic mining industry. Over the years they continued to besiege Washington with pleas for the construction of government-financed high dams. In 1904 the mining interests and their supporters asked President Theodore Roosevelt to send someone to the western mountains to completely reassess the situation. The Caminetti Act, they held, was clearly not doing the job; they wanted the whole matter reviewed and, if appropriate, the act modified along desired lines.

The President responded by dispatching Grove Karl Gilbert, a brilliant geologist, to look into the situation. Gilbert, an exacting and patient scientist, spent several years investigating and publishing the most complete report on mining debris ever written. When completed in 1917, the document recorded every aspect of the debris problem from the Sierra to the sea. In the final analysis it was Gilbert's opinion that the Caminetti Act should not be changed, because if hydraulicking was resumed on a large scale, the rivers, bays and even the Golden Gate would be threatened.

Meanwhile, the mountain interests, looking for a quick and agreeable solution, lost patience with Gilbert and lobbied their cause with continued vigor. In 1907 they were able to secure an amendment to Section 13 of the act which added language that allowed mining to be prosecuted without restraining barriers ". . . where it shall appear to said Commission that hydraulic mining may be carried on without injury to . . . navigation . . . an order may be made authorizing such mining to be carried on without requiring the construction of any restraining or impounding works . . ." The amendment also stated that ". . . where such an order is made a license to mine, no taxes provided for herein on the gross proceeds of such mining operations shall be collected." Though not stated in the added wording, it was implicitly understood that: (1) the act was indeed able to be modified, and (2) that the miners would henceforth be looking to the federal government to build restraining dams.

The new understanding was confirmed, to a degree at least, when the work at Daguerre Point was expanded, and the earlier brush and wood barrier replaced with one of concrete. But even the most obdurate realized that a general revival was not possible due to the altered conditions of the times, and because most of the water supplies that had formerly been under the control of the hydraulickers had passed to power companies and irrigation districts. The fact remained, however, that some of the largest known auriferous gravel deposits laid unwashed in the northern Sierra, and the only means by which they could be worked at a profit was the hydraulic method.

It was believed that at least a portion of the former water supplies would still be available to allow the dying industry to be built up to an annual production estimated at more than a million dollars for a twenty-year period. If this limited rehabilitation was to be accomplished, the debris would have to be impounded at a very low cost; otherwise more than half of the gravel, being of an inferior grade, could not be profitably worked. Once again the high dam was believed to be the only answer to secure sufficient capacity at low cost.

During the first quarter of the twentieth century hydraulic mining in the region of the western Sierra continued to decline. Moreover, inflation following World War I caused even further decline in gold production. Though the mining scene was as bleak as it had ever been, those pushing for rehabilitation continued in their efforts to restore the monitors to the mountains.

In 1925, Assemblyman H.C. Cloudman

The face of determination. Liberty Hill Mine, 1923. (Corps of Engineers' photo)

sponsored legislation that created the California State Hydraulic Mining Commission, which was charged to investigate the "feasibility of any plan or plans whereby hydraulic mining can be resumed in California . . " The Commission was composed of the state mineralogist and the surveyor general, who engaged Arthur Jarman, a former mining engineer, to carry out the field work and prepare the technical report.

On February 17, 1927, the Commission submitted its report to the Legislature. Unlike Gilbert's extensive report published just a decade earlier, the limited Jarman report suggested that hydraulic mining could indeed be resumed, "not only without fear of damage to farming and other interests, but with positive benefit to them, provided that impounding dams be constructed at strategic points . . ."

It was pointed out that an expenditure of about two and a half million dollars would be needed for the erection of three dams and the purchase of storage in a fourth (Bullards Bar Dam), and would enable mining to be resumed on the American, Bear, and Yuba Rivers. However, Jarman reported that

> the available water will only suffice for one-fourth of the activity of the early eighties and the shortage of water will mainly restrict works on gravels above the average in gold content. His forecast is an annual output of gold only one-seventh of that formerly obtained from the district described. Approximately 10,000,000 cubic yards estimated to yield $1,156,000 would be mined annually compared with 38,610,000 cubic yards in 1880, estimated to have yielded $8,000,000.
>
> (*Report of the Hydraulic Mining Commission Upon the Feasibility of the Resumption of Hydraulic Mining in California* (a report to the Legislature of 1927)

The State Commission selected several acceptable dam sites on the American, Bear, and Yuba Rivers, and carried out preliminary surveys in each area, but much further study would be essential before exact sites could be determined.* The State Commission, therefore, recommended that some $60,000 be appropriated for the preliminary engineering work to be done.

Crib work for a new dam to store debris of the Crusade Mine, 1933. (Corps of Engineers' photo)

In addition , it was recommended that the Legislature enact laws to complete the engineering studies of the dam sites; that the overall construction plans be coordinated with those for the development and conservation of the water resources of the state; and that one-half of an estimated $2,405,000 be appropriated by the state for construction of the dams and to purchase reservoir sites. The other half should, according to the State Commission, be provided by the federal government, as was done earlier for the smaller barriers on the Yuba above Marysville.

As for federal legislation, it was suggested that legislation be introduced in Congress that would allow the California Debris Commission to pay for debris storage behind the dams in lieu of building dams themselves. The Caminetti Act was to be amended in relation to the way that miners would pay for storage. It was believed that a charge of three percent of the gross proceeds of a mine was insufficient to repay the cost of construction**; hence the law should be altered so that the charge made per cubic yard mined would produce enough revenue to repay construction costs.

The State Commission listed six benefits to be obtained by the adoption of the above program.

1. Revival of Nevada and Placer Counties due to increased employment.
2. Increased revenue for the valley due to orders for machinery, materials, and supplies.
3. Development of water supplies.
4. Protection of farmlands.
5. Prevention of natural debris from reaching the navigable channels.
6. Dams would provide water for irrigation and power.

On January 20, 1927, Assemblyman Harold C. Cloudman of the Fortieth District (Alameda County) proposed legislation that would, if passed, have appropriated $300,000 for the completion of the preliminary engineering work and for the purchase of the most suitable of the seven

* The CDC conducted studies of these and other sites during this same period.

** The three percent provision was part of the 1893 Act.

damsites under consideration.* In support of his proposal, he offered as evidence the report of the Hydraulic Mining Commission.

On the other hand, valley interests alerted to the new threat had their own engineer at work. Otto von Geldern was hired by the District Attorney of Sutter County to investigate the rehabilitation of hydraulic mining by the building of high dams. As might be expected, von Geldern's study revealed that the resumption of hydraulicking meant certain doom for the valley.

In his report he suggested that regardless of the economic conditions of the time, the whole matter revolved around the safety of the valley and those who resided there. He pointed out that the reliability of such dams as those proposed could not be assured, nor could the effect of the fill on such structures be definitely known. Hence, such barriers would be a grave threat to the valley. Besides:

> It will reflect upon the value of real estate, of productive farms and orchards, and important city properties below it. A man looking for an investment would be sure to consider this as an objectionable feature, and prefer an investment in some locality where there is no possibility of such a menace. (Otto von Geldern, "Analysis of the Problem to Rehabilitate Hydraulic Mining in California" (Speech to the Mineral Resources Section, Commonwealth Club of Calif., Sept. 7, 1927)).

Von Geldern held that the whole idea of rehabilitation was nothing more than a dangerous experiment. He recalled that similar structures had been used in the Alps and Appenines, but that not even these were of the "extraordinary dimensions and of such enormous voluminous capacity to hold back avalanches of debris" as those proposed for the Sierra. Finally, he believed it to be dangerous to "trifle with the great forces of nature which in geological ages have been brought to something like a stable equilibrium . . ."

Valley interests, armed with testimony such as von Geldern provided, eventually defeated Cloudman's bill.

The close of the 1927 legislative session, however, did not mean an end of the battle. Both sides rearmed, using basically the same ammunition.

The next year the Commonwealth Club of California published its findings concerning the conflict. While the group as a whole accepted the majority report that favored rehabilitation, some at least supported the minority view as presented by none other than Otto von Geldern.** In addition to his previous arguments, he added emphasis to his negative findings. He explained that hydraulic mining done in limited operations, behind expensive dams, would not be profitable, especially if the miners had to bear the expense of such dams. Consequently, the cost would have to be paid by the whole state in the form of subsidies that would be impossible to pay back. And it was a well-known fact that valley residents were opposed to a tax designed to finance an enterprise that might spell ruin for them.

Supporting von Geldern were others of note: Professor Robert Unser, Dean of the College of Mines of the University of California, and Ross E. Browne, a well-known mining engineer of the time. And, of course, reference could always be made to the landmark study done by Gilbert. All believed hydraulicking was a menace to the public welfare. In summary, their arguments were: (1) high dams are dangerous; (2) rehabilitation was financially unsound; (3) only a few might prosper at the expense of thousands; (4) future generations would suffer; (5) dams would fill and become useless; (6) the government, state or federal, is not in the mining business, nor would it be sound public policy for either to be so; (7) water was more important than gold for California; (8) new legislation would deprive the people of the right of injunction.

Those who favored rehabilitation were just as dedicated to the merits of their cause. Probably James D. Stewart presented the case for the miners as well as anyone. As he remarked, "I was born and reared within the sound of the roar of the hydraulic monitor and giant. My schooling and living has (sic) been wrested from the gravels of the hills I have always loved." (James D. Stewart, "The Miner's Viewpoint," *The Commonwealth* (May 29, 1928)

Stewart disclosed that during the previous forty years, the damage suffered by the agricultural interests had been largely repaired, and in some cases the land had actually benefited from the debris washed out of the mountains. The hydraulic mining industry, on the other hand, had been wiped out, and during the forty years previous, those who had endeavored to rehabilitate the industry had met only sneers and scorn.

Stewart also pointed to expert opinion in presenting the miners' case. He recalled that Colonel Thomas H. Jackson of the CDC stated conclusively that high concrete dams could be built that would efficiently and permanently impound debris so that it could not possibly injure the lands downstream or restrict navigation in any way. Stewart used the Bullards Bar Dam on the Yuba as an example of the type of dam he felt was essential to rehabilitate the industry. Erected by the Yuba River Power Company, it was completed in 1924. The concrete dam, some 175 feet high, provided both power and a reservoir for debris storage, and at the time of the 1927 controversy was being used by half a dozen mines. Stewart denied the Sutter County contention that valley residents would lose their right of injunction, pointing to the fact that none of the mines operating behind the Bullards Bar Dam had been enjoined. They had not been enjoined because they caused no damage.***

Stewart complained further that while agrarian interests were violently opposed to state or federal aid to the mines, they gladly accepted financial assistance. To

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* Three sites were considered on the North Fork of the American: Owl Creek, Rice's Bridge, and the North Fork site two miles above its junction with the American's Middle Fork. The North Fork site was favored because of location and low construction cost.

** Otto von Geldern was at the time an employee of the Sutter County Board of Supervisors.

*** Stewart, "The Miner's Viewpoint," p. 161. During April of 1926, the flow of water over the dam was 1,700 second-feet or 68,000 miner's inches. The water was found to be clear, the suspended matter being less than 1 part in 10,000,000 parts of water.

the charge that hydraulicking would prove to be unprofitable, he suggested that this was a matter that concerned the hydraulickers alone. Stewart put forth a six-point program covering construction and repayment of the high dams.

1. The state and federal governments make the necessary appropriations to build these dams.
2. That these dams be built by, and be under the supervision of, the California Debris Commission, as at present.
3. That no dams be built on any stream until the hydraulic miners on that stream have filed a written petition with the California Debris Commission, asking that such a dam be built, and deposit sufficient funds with the Commission to cover the initial inspection of the project by the Commission's engineers.
4. That the petition shall state how many cubic yards of gravel the petitioner expects to work.
5. That no dam shall be built until the petitioners file an undertaking or bond that they will work the amount of yardage stated in their petition.
6. That when the dam is built, they will file with the Commission a further bond to cover payment of the storage of the debris behind the dam.

Further, Stewart claimed tremendous direct and indirect benefits would befall the state if the dams were built and hydraulicking resumed. He stated that a total of $600,000,000 could be directly recovered by hydraulicking. He believed some of the indirect benefits would be more far-reaching than the direct. The debris dams would be an integral part of flood control, irrigation, salinity control in the delta region, and the navigation plans of the state as a whole. Moreover, hydraulic work, performed during the winter months, would draw off the unemployment from the cities and farms, thus stabilizing the labor force.

Such evidence, arguments, and expert opinions persisted and grew more intense during the years after 1927. Not since the turn of the century had hydraulicking received such scrutiny or as much active support. When the Legislature convened in 1929, the Seawell Bill, practically a duplicate of the Cloudman Bill, was introduced into the Assembly. Even though strongly opposed by the farmers, the bill was passed by the Legislature, only to be vetoed by the Governor.

Though defeated once again, the supporters of rehabilitation continued the fight. By the early thirties, however, economic conditions provided added force and a sense of immediacy to their cause. A two-pronged attack was initiated, one supporting flood control and the other easing the unemployment problem. The solution to both difficulties, according to the mining interests, was the building of high concrete dams.

In an address to the Miners Association on November 28, 1930, the former State Debris Commissioner, W.W. Waggoner, reminded the group that not only would the dams restrain the old debris from clogging the valley streams, but that such barriers would be a vital part of the entire flood control effort. By restraining both old and new debris (either natural or man caused) the rivers would have an opportunity to scour their beds clean. And, of course, the benefit to farmers by providing needed water for irrigation could not be overlooked.

> If during the dry seasons, the reservoirs are not full, the gates can be closed, and the reservoirs can then be filled from the melting snows. This stored water should be discharged during the summer and fall for irrigation and navigation uses.
>
> (W.W. Waggoner, Address given at the luncheon of the Miners Association of California, at Sacramento, on November 28, 1930 (copy of address in CDC files, U.S. Army Corps of Engineers)

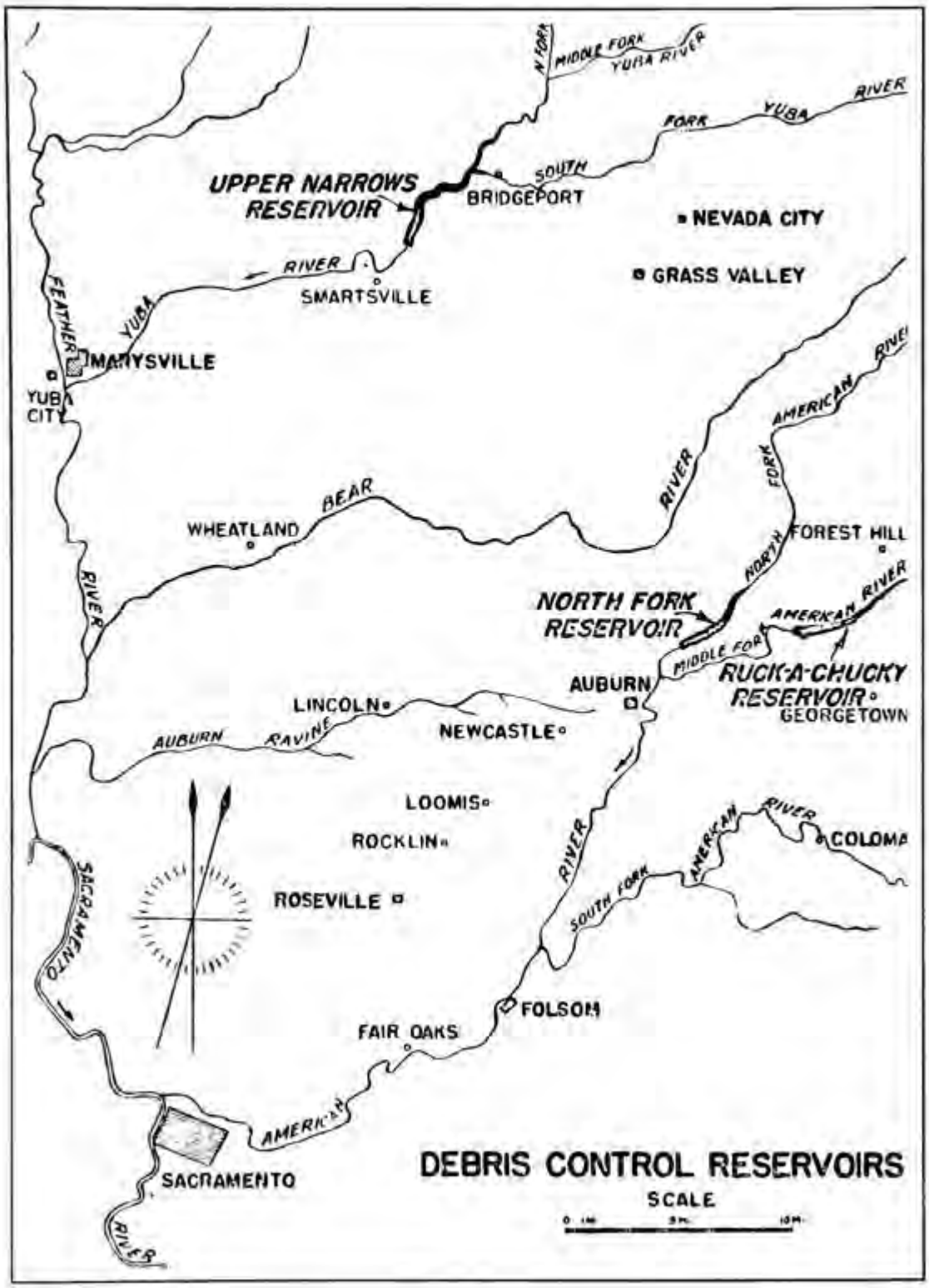
James D. Stewart echoed Waggoner's statement in his letter to Governor Rolph in September of 1931.

> A few years ago a flood in the Sacramento Valley meant the loss of a few cattle, sheep, and other property, and the discomfort of a small population. Today a flooding of this area is too ghastly a thing to contemplate from the standpoint of the loss of life, let alone the great property loss.
>
> (James D. Stewart, Letter to Governor Rolph, September 1931 (California Debris Commission Files)

In his letter, Stewart recalled for the Governor that the 1924-25 Legislature had appropriated $10,000 to investigate the feasibility of resuming hydraulic mining. That the next Legislature came within one vote of passing the Cloudman Bill was also pointed out for the Governor. Stewart reminded Rolph that the Seawell Bill, aimed at carrying out the recommendations of the Hydraulic Commission to reopen the mines with certain restrictions, passed both houses of the Legislature, only to be vetoed by the Governor. The favorable eight-month study by the Commonwealth Club was likewise included by Stewart in his plea that the difficulties of the mining community be given serious consideration when the Governor called for a special session of the Legislature. Besides protecting the valley from floods, dam construction and other components of the Statewide Water Plan would give employment to thousands. Stewart suggested that the same was true for hydraulic mining. "A little aid and encouragement will not only put this great industry on its feet, sending a flood of gold to the marts of trade, but will give employment to thousands of men. Fifty thousand is not too small an estimate."

As the economic crisis became more acute throughout the state, the voice of opposition to rehabilitation of hydraulicking became muffled and was finally overwhelmed by those favoring revival. On the national level, Harry Englebright, Congressman from Nevada County, finally convinced Congress to aid in reviving the potentially profitable industry. In the summer of 1934, he was instrumental in securing an amendment to the Caminetti Act allowing the construction of high dams, and on this occasion sufficient funds were appropriated to ensure completion of the barriers. The federal government, in return, would be repaid by those using the dams.

> The individual, company, or corporation operating thereunder working any mine or mines by hydraulic process, the debris from which flows into or is in whole or in part restrained by such dams . . . shall pay for each cubic yard mined from the natural bank a tax equal to the total capital cost of the dam, reservoir, and right of way divided by the total capacity of the reservoir. . .
>
> (*Act to Create the California Debris Commission and Regulate Hydraulic Mining in the State of California*, as amended to January 1, 1938 — Reprint of Act from CDC files)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NEVADA CITY
GRASS VALLEY
RIVER
SMARTSVILLE
FEATHER
YUBA
MARYSVILLE
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AMERICAN
RIVER
FORK
RIVER
BEAR
WHEATLAND
RIVER
NORTH
FOREST HILL
NORTH FORK
RESERVOIR
AMERICAN RIVER
MIDDLE FORK
RUCK-A-CHUCKY
RESERVOIR
GEORGETOWN
AUBURN
LINCOLN
NEWCASTLE
AUBURN
RAVINE
LOOMIS
ROCKLIN
ROSEVILLE
RIVER
AMERICAN
RIVER
COLOMA
SOUTH FORK
SACRAMENTO
FOLSOM
FAIR OAKS
AMERICAN
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Bear State Mine Dam, October 1938 (Corps of Engineers' photo)

Lost Camp Mine, August 1939. (Corps of Engineers' photo)

In August of the next year, Congress approved a project for the development of storage facilities on the Yuba, Bear, and American Rivers having a total estimated cost of about seven million dollars. The project called for a dam 237 feet high to be built at the Upper Narrows of the Yuba, some two miles northeast of Smartville. The dam on the Middle Fork of the American at Ruck-A-Chucky, approximately twelve miles east of Auburn, would be 148 feet high and provide storage for 24,000,000 cubic yards of debris. On the Bear River a dam was supposed to be constructed at Dog Bar, about six miles above the Combe Dam.* Also called for in the project was the development of a site on the North Fork of the American River about two miles above the junction of the North and Middle Forks. The proposed barrier would be 139 feet high and provide storage for 26,000,000 cubic yards of new mining debris. (*Hydraulic Mining and Debris Control, Sacramento River and Tributaries, California* — Corps of Engineers, U.S. Army, Sacramento, January, 1944).

The same act adopting the project of building the four dams also stipulated

> that work shall not be begun on any reservoir until the repayment of the capital cost thereof by the payment of taxes on materials hydraulically mined from the natural bank . . . is assured to the satisfaction of the Secretary of War.
>
> (*Funds for Maintenance Work on Hydraulic Mine Debris Dams*, letter to the Chief of Engineers, U.S. Army, by H.E. Northup, Corps of Engineers, South Pacific Division, October 5, 1942 — CDC Historical Files)

In addition to guaranteed repayment, the federal government required four other assurances: (1) that the gravels to be washed contained sufficient quantities of gold to justify mining, (2) that sufficient yardage existed, (3) that the owner had or could secure water supplies sufficient for operation, and (4) that the owner had sufficient financial resources to install the necessary equipment and hire the men to carry on operations. (*Report on the Status of Assurances Re. Debris Control on the Yuba and Bear Rivers and North and Middle Forks of the American River*, California Debris Commission Files, Box 3 of 4)

Debris, Small Hope Mine, 1936. (Corps of Engineers' photo)

The stage seemed to be set. All that the miners needed to do was present the government with reasonable assurances and the high dams would be built. It appeared, however, that no one was prepared to give such assurances. The combative operators of the eighties and nineties were long retired or dead, and it seemed that the new generation was apathetic. In some cases the second and third generation descendants of the original owners proved indifferent if not hostile to the idea of working their properties. Once again the mining proponents realized that to achieve their goals they must organize. In February of 1935, thirty-three individuals met in Grass Valley to form the California Hydraulic Mining Association, Incorporated. This organization is not to be confused with the militant group operating in the last quarter of the nineteenth century. Of the men who belonged to the new organization, not one had mined in the old days, and less than half a dozen of the new breed could operate a nozzle. As George Hallock, president of the Association, pointed out, "Hydraulic mining as late as 1935 was as prostrate as a rural graveyard." (*Mining and Industrial News*, November 15, 1939)

The group pressed on, however, with a single goal, that of breathing enough life into the industry to meet the government requirements. Working diligently, the little group, which over the next few years grew to over a thousand members, finally secured the necessary guarantees. In a letter to the California Debris Commission dated March 25, 1937, J.P. Hall, president of the Miners Association, stated that "sufficient guarantees have been filed with the California Debris Commission to guarantee the construction of the North Fork Dam. . ." (J.P. Hall, letter to Maj. W.E. Harris, U.S. Army Corps of Engineers, March 25, 1937) Only thirteen days later Congressman Englebright advised the miners that the guarantees and assurances had been accepted in Washington and that construction would soon get under way. Curiously, of all the mines on the North Fork of the American that could feasibly use the soon-to-be-constructed

* The Nevada Irrigation District built the Combe Dam on the Bear River in 1928 some 37 miles above the river's mouth and about 3½ miles west of Clipper Gap. Debris storage space in the reservoir was sold to the mines above the dam until November 1938, when mining was stopped by court action. It seems that water was diverted from the river at a point between the mines and the reservoir, and before there was an opportunity for debris settlement.

dam, only three were able to furnish the federal government with the required assurances. In every category, from water available to expected net profit, the miners' estimates were exceedingly more optimistic than those of the government. Nevertheless, the assurances were accepted and on March 5, 1938, bids for construction were advertised. A month later the bids were opened and, of the fifteen companies that proffered bids, A. Teichert and Son of Sacramento submitted the lowest, of $345,987.*

For more than half a century men had dreamed of building high dams in the Sierra to control hydraulic mining debris. Tempers had flared, legislative battles fought, studies made, organizations formed and re-formed, and thousands of hours of effort expended. Victory, which had so often eluded the mountain communities, was finally achieved, some fifty years after the mountain-valley clash began. During the intervening half century, conditions were vastly altered, and the victory of 1938 would prove to be an empty triumph.

Of the four dams authorized, only two, North Fork on the American and Upper Narrows (later Englebright) on the Yuba

Ruck-a-Chucky dam site, 1933. (Corps of Engineers' photo)

* The estimated cost of all four reservoirs (1935) was $6,945,000.

Proposed dam site on the lower Bear river, 1934. (Corps of Engineers' photo)

were built. Because of generally unstable soil conditions, and finally a landslide, the Ruck-A-Chucky Dam on the Middle Fork of the American was never completed.* Moreover, construction of the proposed Dog Bar Dam on the Bear River was delayed and eventually abandoned because of litigation that prohibited operation of the most valuable mines in the drainage area.

Geological investigation of the rock structure and the overall foundation characteristics of the Upper Narrows and North Fork sites showed each to be acceptable. Because of these factors and due to the comparatively small span of crest elevations compared with the height of the dams, the single-arch type of structure was selected for these sites.

Moreover, comparative cost estimates demonstrated conclusively that arch dams could be constructed at substantial savings over the more traditional concrete gravity-type structures. Finally, because of the extensive flood flows on both the Yuba and American Rivers, the cost of spillways and diversion works for rock-fill type dams made those kinds of barriers prohibitive in cost.

During the 1930s designing arch dams was accomplished largely by trial. Numerous designs were made and analyzed in terms of arch thrust, bending movement and radical shear at any point due to water load as well as the crown deflection for arches. In this pre-computer time, all known analytical studies were employed by the Debris Commission in preparing plans for the two dams to be constructed.

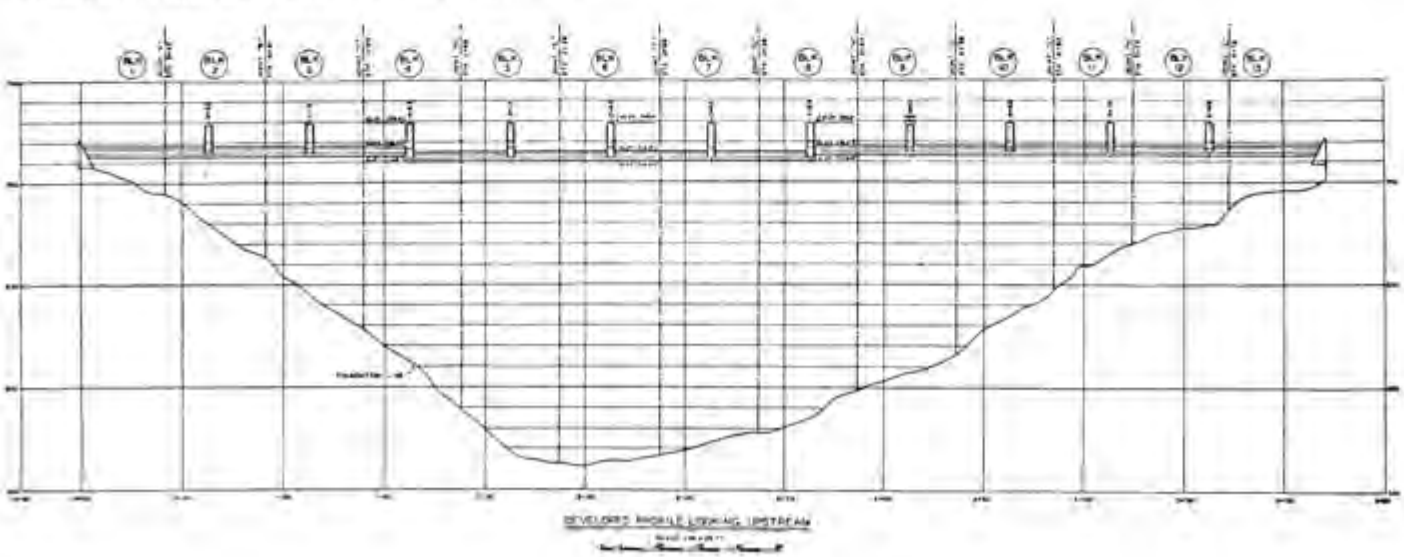
Before drafting final plans for these dams, it was necessary to investigate the pressure developed on the upstream face of the dams due to the debris to be impounded in the reservoirs. Samples of similar debris was taken from existing debris reservoirs and shipped to the Corps of Engineers' Waterways Experiment Station at Vicksburg for the purpose of determining experimentally the unit pressure to be used. As a result of the Vicksburg experiments and analysis of data collected, the Debris Commisson concluded that the pressure exerted by the debris would be equivalent to that exerted by a perfect fluid having a weight of slightly less than 70 pounds per cubic foot. Consequently, the California Debris Commission adopted 70 pounds as the equivalent loading to be used in the design of the dams.

Both the North Fork and the Upper Narrows dams were designed to be overflow structures with no separate spillway structures provided. Arch dams in general are particularly well suited in this respect. The determining criteria are: (1) the bedrock upon which the dam is constructed must be sufficiently massive and durable so that it will not be injured by the impact of the overflowing water; and (2) an adequate supply of air must be admitted under the nappe so that alternative forming and breaking of a vacuum will not set up undesirable vibration. The bedrock at the Upper Narrows and North Fork sites adequately met the first criterion, and the second was satisfied by designing adequate aeration piers for the crests of the dams.

The Debris Commission, realizing the technical limitations available to them in analyzing the dam sites, required the contractor to complete all excavation work prior to the commencement of concreting. The Commission knew that, in the case of arch dams, if the final excavation disclosed foundation conditions materially different from conditions assumed as a result of exploratory work, it would be necessary to re-design portions of the dam(s).

Although a great deal of study had been done relative to arch dams by the time of the Depression years, the Commission knew that much was still to be learned and wanted to contribute to this body of knowledge. The experimental work completed to that time led to the theory that the true stresses developed by arch dams were much less than those computed by using generally accepted analytical methods of the period. To determine the true stresses developed, the CDC proposed to imbed electric strain gages within the dams. It was hoped that a small expenditure of funds for strain gages would result

* Stop-work order issued by CDC effective May 27, 1940, to the contractor for this dam because of a major slide of material at the left abutment.



Index No.	Labor Classification	Minimum rate per hour set by U. S. Dept. of Labor.
1	Asphalt Workers	$ .77
2	Blade Grader Operator (Finish Work)	1.25
3	Concrete Worker for Structures Wet and Dry	.77
4	Carpenters	1.10
5	Crane and Derrick Operators	1.25
6	Common Laborers	.62½
7	Dragline Operators except Shovel Type	1.25
8	Drill Runner	.90
9	Electrician	1.37½
10	Finisher Rough Concrete	1.10
11	Fireman	.90
12	Gunite Workers	.90
13	Grader Operator (Towing or Motor Rough Work)	1.00
14	Hoist Operator (Building Materials)	1.37½
15	Hoist Operator (Structural)	1.50
16	Iron Worker Reinforcement	1.25
17	Jackhammerman	.90
18	Laborers, bridge	.69
19	Mechanic (Trouble Shooter)	1.10
20	Miner (Machine and Timber Men)	.90
21	Mucker (Laborer underground)	.80
22	Mucking Machine Operator	1.25
23	Cableway Operator (High Line)	1.37½
24	Power Shovel Operator or other Excavating Equipment with Shovel Type Control (3/4 cubic yard or moer)	1.50
25	Oilers	.90
26	Plumbers	1.50
27	Powderman	.90
28	Compressor Operator	1.00
29	Concrete Mixer Operator (1 cubic yard and over)	1.25
30	Concrete Mixer Operator (Under 1 cubic yard)	.93
31	Roller Operator	.90
32	Roller Operator finishing high type pavement including subgrade for same	1.25
33	Rigger, structural	1.50
34	Structural Steel Workers	1.50
35	Sloper	.75
36	Swamper for Draglines	.90
37	Tractor Operator (50 horsepower and over)	1.25
38	Tractor Operator (under 50 horsepower)	.75
39	Truck Driver (4 cu. yd. water level capacity or more)	.75
40	Truck Driver (less than 4 cu. yd. water level capacity)	.68
41	Blacksmiths	1.10
42	Nozzlemen (Gunite Worker)	1.25

SCHEDULE OF WAGE RATES

Index No.	Labor Classification	Minimum rate per hour set by U. S. Dept. of Labor.
1	Blacksmith	$ .82
2	Concrete worker for structures (wet or dry)	.77
3	Carpenters	1.125
4	Common laborers	.625
5	Dragline operators (except shovel type)	1.375
6	Drill runners	.825
7	Electricians	1.375
8	Finishers (rough concrete)	1.10
9	Hoist operators (building material)	1.375
10	Ironworkers (reinforcing)	1.25
11	Jackhammermen	.825
12	Mechanic (troubleshooter)	1.10
13	Operators of power shovel or other excavating equipment, shovel type controls (3/4 cu. yd. or more)	1.50
14	Oilers	1.00
15	Powderman	1.00
16	Compressor operators	.90
17	Concrete mixer operators (1 cu. yd. and over)	1.25
18	Concrete mixer operators (under 1 cu. yd.)	.93
19	Rigger (structural)	1.50
20	Sloper	.75
21	Swamper for dragline	1.00
22	Tractor operators (50 H.P. and over)	1.50
23	Tractor operators (under 50 H.P.)	1.50
24	Truck Drivers (4 cu. yd. water level capacity or more)	.75
25	Truck Drivers (less than 4 cu. yd. water level capacity)	.75
26	Welder, work to be done by craft having jurisdiction over task to which welding is incidental.	

in the addition of valuable information regarding the design and construction of future arch dams.

The shrinkage of concrete due to the dissipation of chemical heat of setting was to be offset by designing the dams with radial contraction joints to be placed at regular intervals. After the heat of setting was entirely dissipated, and before final closure of the diversion works, the Commission planned to pressure grout the contraction joints to offset the shrinkage developed. As an aid in determining the exact moment to complete the grouting process, the Commission asked that electric resistance thermometers be imbedded in the concrete of the structures.

The California Debris Commission opened construction bids for the North Fork Dam on April 5, 1938, and subsequently awarded a contract to low bidder A. Teichert and Son of Sacramento. Teichert construction crews began clearing operations at the site on about May 1st. By the middle of June excavation of both abutments was under way. The total volume of excavation was only about 30,000 cubic yards, but because of the physical difficulties encountered in making a narrow cut on the steep hillside, progress was comparatively slow. Moreover, the melting of a record snow-pack that year also caused some problems for the construction crews and tended to slow the excavation operation.

The river was not diverted until most of the excavation was completed. Diversion was accomplished by means of a six-by-eight foot timber flume having a capacity of 400 c.f.s. An upstream cofferdam was constructed using the rock which had been excavated from the abutments, then faced with clay to make it watertight. A similar dam was constructed downstream but not initially sealed because it was believed that the backflow into the foundation area would not be a serious problem. When pumps had to be installed to drain the area, intensive work was quickly begun to make the downstream cofferdam watertight. This was achieved by driving a double row of sheet steel piling to rock, the material between the rows mucked out by hand and a concrete seal poured.

By September the excavation work was finished and work on the dam proper begun. Once the structure was higher than the level of the river, the wooden flume was taken down and the water allowed to flow through a 7½-by-12 foot opening built into the bottom of the dam.

Cement for North Fork Dam was purchased from the Calaveras Cement Company and manufactured at their San Andreas, California, plant. Construction regulations demanded that two different kinds of cement be used in the project. The first was standard Portland-type and the second, which comprised the bulk of material used, was a modified low-heat variety. Delivery was made in paper bags, shipped by rail to Auburn and then by truck to the dam site. Approximately 40,000 bbls. of cement were used at a cost exceeding $100,000. Once at the site the sacks were emptied by hand into the batching supply hopper.

Teichert and Son secured aggregates for the concrete by setting up a washing and screening plant about two miles downstream from the dam. Besides producing clean gravel for construction purposes, the operation was also a modified hydraulic mining operation. The contractor built a sluice box beneath the gravel-washing machinery to collect the gold separated from the gravel. It has been estimated that more than a hundred thousand dollars in gold was recovered from the company's sluice.

Mass concrete used in the dam was Class B mix, the strength of which was well in excess of the 3,000-pound-per-square-inch requirement set by the Debris Commission. Vertical contraction joints were placed at fifty-foot intervals around the dam. The blocks were poured in five-foot lifts with an interval of from 72 to 96 hours required between pours. The Commission exercised great care to insure the

proper bonding of the various lifts. About six hours after completing the concreting of a lift, the top surface of the lift was "cut" by washing with a high pressure air and water jet. This effectively removed all laitance off the top one inch of the concrete except imbedded coarse aggregate. Just prior to placing the next lift on this concrete, the top surface was again washed with the air and water jet. Mortar, having the same sand-cement-water ratio as the mass concrete, was then placed on the lift and scrubbed into the top surface with wire brushes after which deposition of the mass concrete proceeded.

The actual placement was usually done from four o'clock in the afternoon to midnight, but on occasion was begun during the earlier part of the day. The average production was about 300 cubic yards per day with a maximum of 440 cubic yards being placed in any one day. Concrete was handled in three-yard bottom dump buckets by a pair of hundred-foot guy derricks operated by electric hoists. In addition to the guy derricks, a stiffleg derrick with a ninety-five-foot boom was used at the left abutment.

The concrete buckets were moved from the mixer to within reach of the derricks by means of a wooden trestle extending from the mixing plant to midcanyon. The trestle itself was placed on a slight downgrade so that the small cars on which the buckets rode would move by gravity. Once emptied they were returned to the plant by an electric hoist.

The first batch of concrete for the North Fork Dam was placed in the riverbed on the afternoon of September 26, 1938. Concrete placement continued without serious interruption until the structure was completed. In total, approximately 30,000 cubic yards of concrete were placed in the dam. By February 28, 1939, the last of the concrete was placed, and by the end of March the grouting process was finished.

Only a single major design change was made during the construction of the North Fork Dam, and approved by the California Debris Commission. Upon the recommendation of consultants, it was decided to spread the footing of the dam on the left bank of the river because the foundation rock in that area was fractured to a considerable degree. This was achieved by halting the arch ring forms on each of the five-foot lifts before they reached the sloping base of the cut. The spread footing

Galt, California
September 30, 1936.

Major W. E. Harris
California Debris Commission
Sacramento, California

My dear Major Harris:

In answering your question of why the Bullard's Bar restraining Dam has not been more extensively used up to the present time, this is due to very evident facts, when the situation is studied.

First - That most of these mines are small, and it has been impossible to combine them in such a way, as to interest sufficient capital;

Second The water supply is limited, and many of the mines have not been able to get sufficient water for economical working;

Third - Due to small holdings, and absolutely inexperienced management, many of the mines have tried to operate without engineering advice and too limited capital -- resulting in drainage tunnels being driven where they did not bottom the channels, and with too small a grade;

Fourth Many of these mines have been promoted by men entirely without knowledge of hydraulic mining, with the main object of getting promotion fees;

Fifth - In many cases, the overburden has been so heavy, that a competent mining man, would not attempt to work it;

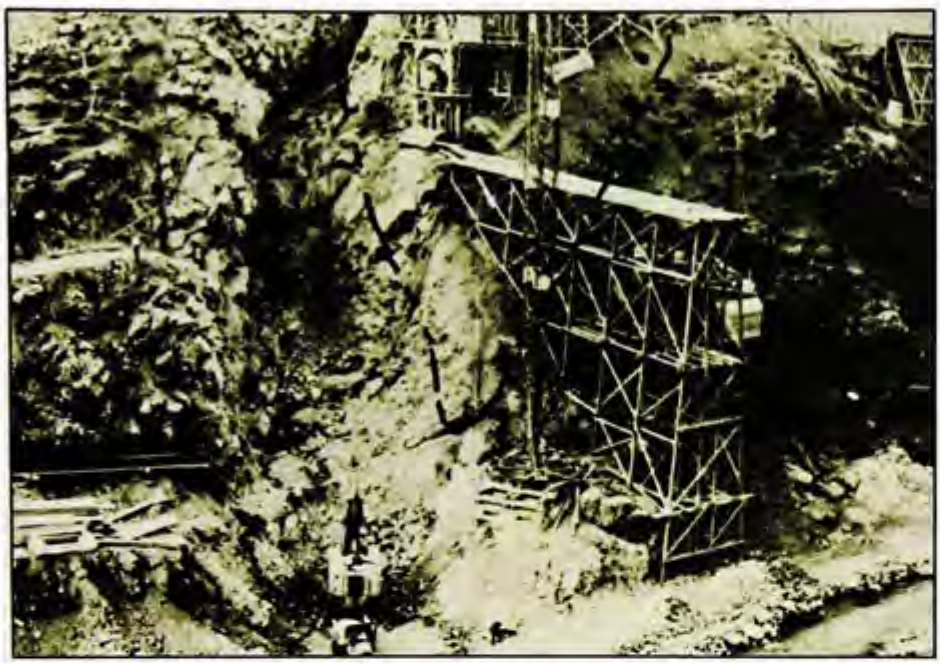
Sixth - Many companies have been formed in which their stockholders have not been advised, as to the amount of money or the time, it would take to get returns;

Seventh These conditions do not apply to the American Rivers and Yuba River gravel deposits, as these are held in sufficiently large blocks to employ competent engineers and to raise sufficient capital to adequately plan operations and water supply.

I am enclosing a report of mine, on the mines in Slate Creek, also a general description of the mines on this water shed, by a competent engineer, whose identity, I am not at liberty to divulge.

Respectfully submitted,

E. A. Starry E. M.



Progress photo of left bank showing foundation excavation nearly completed (8/10/38). The area outlined was involved in the landslide during the spring of 1940.

Left abutment, completed arch ring at elevation 718; also foundation for abutment wall 1/8/39.

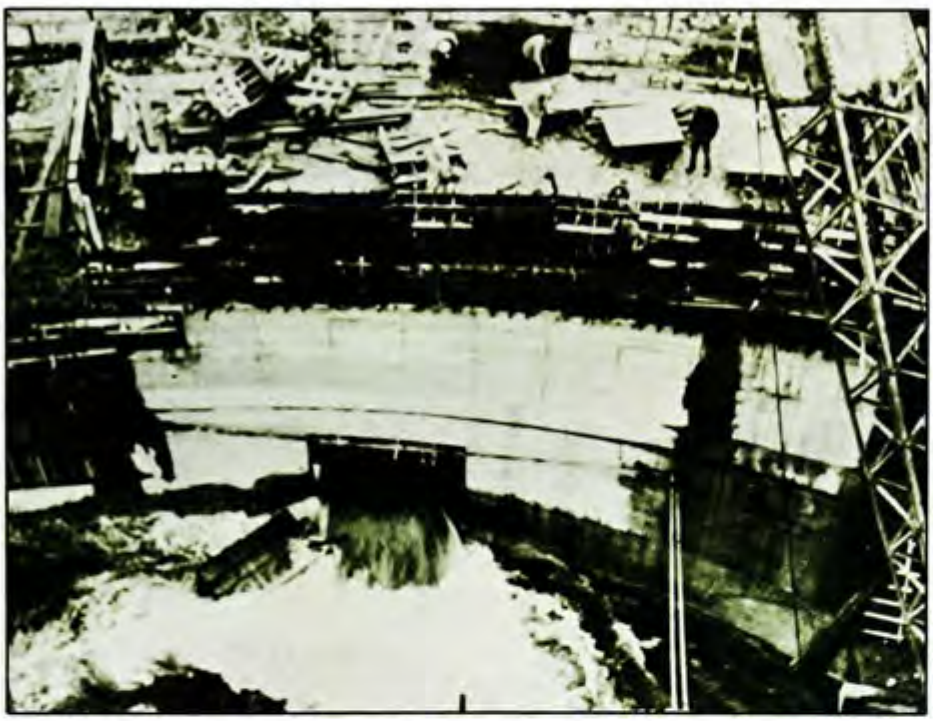
took the form of stair steps five feet high. Each was spaced to provide a footing varying from five to ten feet in thickness. In addition to providing additional strength to the dam, these step-like reinforcements facilitated the setting of forms and provided an excellent working space for drilling and grouting the foundation of the dam proper.

One of the final construction activities was to fit the rectangular water passage built into the lower portion of the dam with a steel gate. The gate was secured in place over the hole on March 27, 1939, effectively shutting off the stream flow. The opening was filled with concrete and then pressure grouted. Less than a week later the reservoir filled and water spilled over the dam at 11:00 p.m. on Sunday, April 1, 1939.

It will be remembered that the North Fork Dam was designed and built very closely to state-of-the-art theoretical thin arch design. Additionally, the California Debris Commission expected that the dam would eventually be subjected to a full debris load. To gather data about real performance of the structure, thirty-two strain gauges were installed in the dam at selected locations and at various angles. In addition to these, joint meters and resistance-type thermometers were also placed in the dam according to CDC contract specifications. All of the information generated by these instruments was carried through the dam by lead wires to an outlet box in the Commission's office near the left abutment. It was planned to monitor the readings for several years.

As a result of heavy rains the following winter and because of the supersaturation of the rock mass overlying the area caused by the overflow from the dam during high water, several landslides occurred near the downstream face of the dam. Sometime between 3:00 p.m., April 8, and 2:00 p.m., April 11, 1940, a slide occurred which carried the Commission's monitoring office several hundred feet downhill. The remains of the little building came to rest as a jumbled and broken mass beneath the downstream face of the dam.

Fearing that such an eventuality might come to pass, the Commission had most of the metering devices removed prior to the time of the slide. While no one was injured in the mishap, the Engineers were quite disappointed and considered the



General view of cable recesses on downstream face of dam, showing cable recess above river diversion work (11/3/38).

Strain meter installation with pipe supports partially covered with concrete (10/28/38).

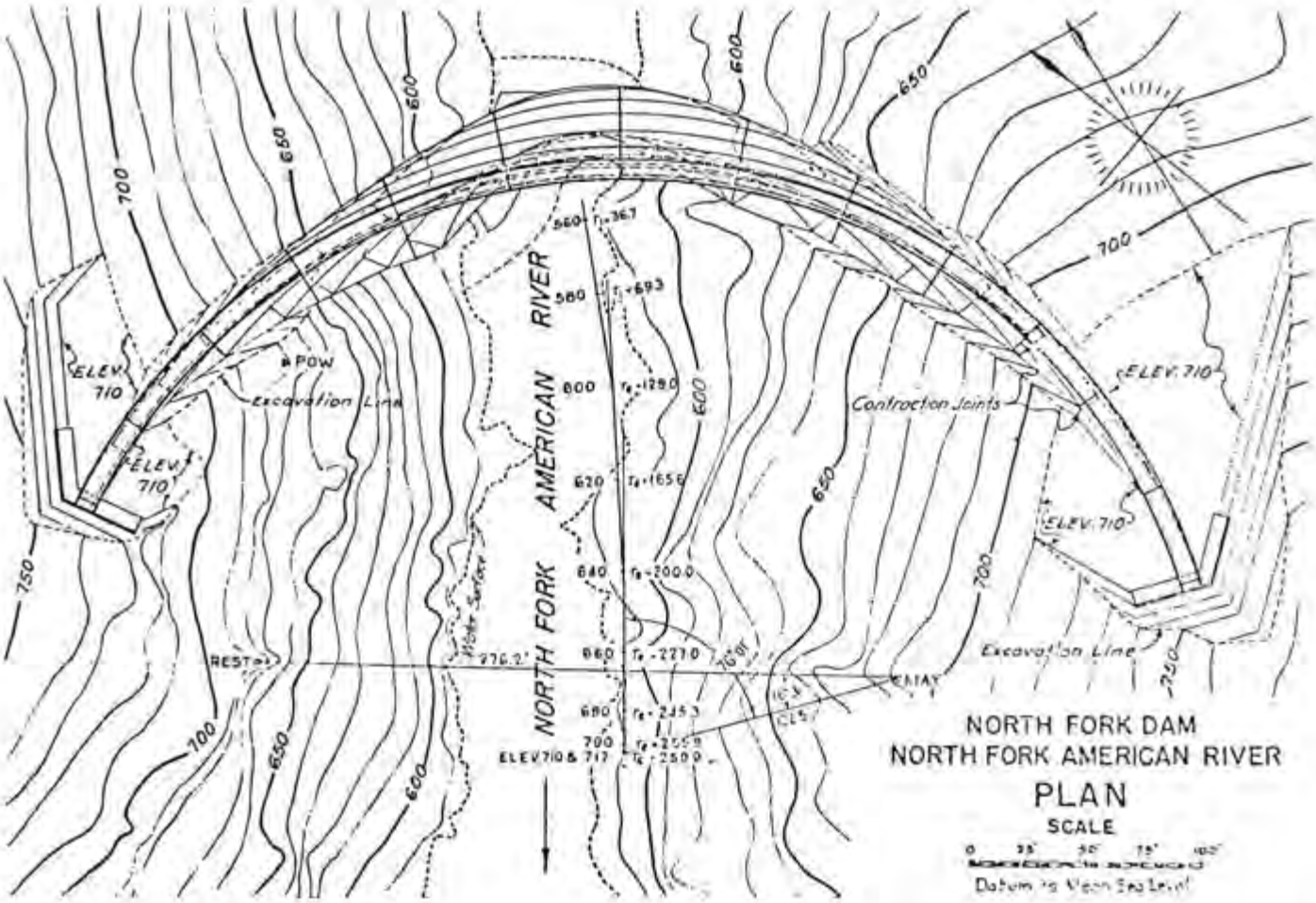
Resistance thermometer installation after cable grooves on top of pour were filled with grout (10/28/38).

Finishing spillway crest in block 13 at elev. 718 (12/23/38). The rock in the upper right hand corner was involved in the landslide during the spring of 1940.

Left abutment of dam. Note 3½" conduits for strain meter cables (3/23/38). Above shows something of the foundation material of the left end of dam now hidden by retaining wall.

Arrows indicate cable recesses on downstream face of dam. Workmen are drypacking upper cable recesses.

North Fork Dam, partially completed, January, 1939 (upstream face).



incident a serious blow to their research effort. With the connections broken and the recording instrumentation gone, the internal conditions of the dam could not be evaluated.

Other slides occurred in the area during following months, but caused little damage other than destroying a portion of the road leading to the dam. To protect the dam abutment against the possibility of future injury, the Commission awarded a contract for repair and reinforcement.

Bids for the construction of the Upper Narrows Dam were opened by the Commission on November 29, 1938, some eight months after the contract was awarded for the North Fork project. The low bidder for the Upper Narrows work was the team of Arundel Corporation and the L.E. Dixon Company. By Christmas, the contractor began operations by constructing access roads to various parts of the left abutment of the dam site.

During the first two months of 1939, the contractor built offices, a mess hall, a dormitory and a low-level suspension bridge which afforded access to the right abutment area. During the same period compressor plants were put up, a substation developed and a water system completed. Before winter was out, additional access roads were built and excavation for the dam (both abutment areas) undertaken. Concurrently with this work, a separate facility for CDC and other Corps of Engineers employees was being constructed under another contract. Four cottages, two dormitories, a mess hall and a first-aid building were the principal buildings erected at this camp.

Just as was true for North Fork, the specifications for Upper Narrows Dam required completion of all excavation before placing concrete, and further required that excavation begin at crest elevation and proceed downward. The inclusion of these provisions by the Commission were particularly justified in view of the developments at the Upper Narrows site. As excavation proceeded during the spring months of 1939, a slip was encountered in the right abutment area.* This slip, which had not been discovered during the exploratory work, sloped towards the stream bed and downstream from the dam. It was immediately apparent to the Debris Commission that excavation would have to be extended to bedrock below the slip. While this greater depth of excavation would have meant only an increase in the

* Fractured rock due to movement, faulting, along a horizontal plane.

Upper Narrows Dam Site, Yuba River, 11/13/36. (Corps of Engineers' photo)

Upper Narrows Dam Site, Yuba River, July 20, 1937. (Corps of Engineers' photo)

amount of concrete placed if a gravity-type dam was being built, in the case of a thin arch dam it meant that substantial redesign of the structure was required. Had the contractor been permitted to excavate in the stream bed section and then place concrete before discovering the upper abutment conditions, the Debris Commission would have been committed to the exact location of the crown section of the entire dam, meaning that a proper — and possibly safe — design for the structure as a whole would have been impossible to execute when it was found necessary to increase the depth of excavation.

The vertical depth of excavation on the right abutment had initially been estimated to be 55 feet throughout a large part of its length. This specification was necessarily increased to 110 feet (double the original plan) for part of the length, meaning that almost 50,000 cubic yards of material in excess of the first estimate would have to be displaced.

Due to the close quarters in which the excavation had to be done, it was not possible to use more than a single power shovel at any time, nor to employ additional equipment of any kind. The contractor's monthly rate of excavation on the right abutment could be maintained but not significantly increased. It soon became evident that excavation and concrete placing in the stream bed would, therefore, be delayed until near the end of the year, making these operations and river diversions hazardous, as heavy rains could be expected anytime after the first weeks of November.

So that the river could be diverted to allow excavation of the stream bed, the contractor built a retaining wall along the right bank just above the low water level. It was planned that this wall would confine the river's flow to the area between the river and the right bank. The downstream end of this new channel was connected to a timber flume and extended downstream past the area chosen for the downstream cofferdam. A timber crib filled with rock served as the upstream cofferdam. This barrier was only marginally successful in that it leaked rather badly. To correct the situation, the contractor put up an earth fill dam upstream of the cofferdam. This didn't seem to work much better than the original cofferdam. Finally, these less-than-successful efforts were disregarded, and concrete cofferdams were set in place.

River diversion was accomplished on November 23, 1939, and the streambed excavated with all deliberate speed in the desperate hope that all concrete for the streambed section could be placed well above the low water mark prior to the first heavy winter storm. For awhile at least it looked as though the crews would make the pours before the winter rains hit them. Streambed excavation was completed, some forms set and the initial concrete in the dam placed by December 19, 1939. The concrete was placed in five-foot lifts, in alternating fifty-foot long blocks, as quickly as the Commission's specifications would allow. Luck ran out just after the Christmas holiday. During the closing

days of December, heavy rains caused the Yuba to rise. Shortly after midnight on January 2, 1940, the capacity of the diversion works was exceeded and the entire area between the cofferdams flooded.

As the flood rose, the wooden flume forming the downstream extension of the diversion channel was carried away by the swollen river and sent on its way toward Marysville. By the next day, January 3rd, the Yuba had risen to the point where only the forms for Block 16, the highest block on the left bank, were above the churning river. By the middle of the month, the Yuba had receded sufficiently to allow the diversion channel to once again carry the flow. The high velocity of the flood, it was found, had washed sand, gravel and large boulders over the upstream cofferdam and deposited them in the excavation and over most of the concrete already put in place. Crews went to work immediately to clean up the mess. Before long, concrete was again being placed in the streambed portion of the dam.

During the latter days of January, yet another storm visited the area and once again the upstream cofferdam was overtopped. It became obvious to all concerned that no appreciable progress could be made on the streambed section blocks until after the end of the rainy season. From the end of January until the middle of June 1940, the contractor confined construction activities to the placing of blocks on both abutments.

The rainfall season of 1939-40 was one of the wettest in the history of California. A pair of major floods of enormous proportions spread damage over a wide area. Moreover, the snow pack, resting high on the Sierra slopes, indicated that the runoff would probably be greater than normal. Thus it was not until June 13, 1940, that the streamflow of the Yuba River could be confined to the diversion channel and pumping started in the area between the cofferdams.

Once the streambed section was finally dewatered, it was found that a large amount of debris had again been washed into the area. All forms, which had been in place in January, had been either washed away or badly damaged. Even the sheet metal water and grout stops, which had been imbedded in the ends of blocks previously poured, had been torn away. Before resuming concreting operations, it was necessary to replace and repair forms

Upper Narrows (Englebright) Dam, Yuba River, California (Corps of Engineers' photo)

and to braze metal strips to the exposed portions of damaged grout and water stops. The first concrete placed in the streambed section was completed on June 18th.

As the construction of the center portion of the dam proceeded, a large opening was left so that the stream flow could be re-directed from the right bank portion of the dam site. The upstream face of the dam was constructed with concrete guides for a heavy slide gate which would be dropped over the opening to effect final closure. This gate was constructed of 12" × 20" timbers backed with reinforced concrete and the face of the gate rabbeted to receive a section of fire hose laid flat and covered with rubber belting. When the gate was finally seated, the hose was inflated, forcing it against the face of the dam and thus forming a very effective seal.

By the middle of July, the stream bed section of the dam had been raised well above the elevation of the upstream cofferdam. This cofferdam was subsequently dynamited, permitting water to pass through the opening in the dam. Stop logs were then placed in the intake works of the diversion channel, the right bank dried out and final excavation of that area completed.

From the first of August until late in the year, every effort was made to place as much concrete as possible. Shifts worked daily and the batching plant was operated at capacity. Concrete placement proceeded without incident through the summer and fall. The final lift was placed on December 19, 1940, leaving only the aeration piers on the spillway crest to be placed. The closure gate over the diversion opening was dropped the following day and filling of the reservoir began.

A heavy rain storm swept over the watershed of the Yuba River on December 21st quickly filling the 70,000 acre-foot reservoir. Even though the gate of the power outlet structure was left open and the tunnel was discharging 2,400 second feet, the reservoir filled and overflowed on December 26, 1940. The following day the head over the spillway reached an incredible 7.2 feet, which corresponded to a discharge of 34,000 second feet. Once the storm quieted, the level of the Yuba dropped to the point where the entire stream flow could pass through the

tunnel. The contractor promptly formed and poured the aeration piers and completed some other minor work.

With the completion of the debris dams, the Commission expected a significant increase in hydraulic operations. During the summer of 1941, there were 41 active mines operating under licenses from the CDC. None were large, and many carried on but little work. Nonetheless, dozens of would-be miners were stalking the old pits and developing plans to re-open some of the more promising ground.

Such dreams were not without foundation in fact. As of 1940 gold output in California totaled nearly $51,000,000. This was the most valuable annual output since 1856. Thousands of miners were employed in the quartz (hard rock) mines at Grass Valley, Alleghany, Nevada City, Jackson, Sutter Creek, Jamestown, Mojave and French Gulch. In addition there were several active and paying dredging operations producing significant quantities of gold each year. Thus, it was not totally unreasonable to think that with the new debris dams hydraulicking might make the long hoped for comeback.

Just as things were beginning to look favorable, the outbreak of World War II altered the economic and labor conditions. Finally on October 8, 1942, War Production Board Limitation Order L-208 caused the gold mines of the state to be closed.

On July 1, 1945, Order L-208 was lifted. Some of the dredging operations were resumed, as were a few of the important lode mines. During that year the Debris Commission was regulating the activities of 23 hydraulic mines, five of which were storing their debris behind the new dams. According to the annual report of the Commission, these were new (or re-opened) mines. That same year Congress re-named the Upper Narrows Dam the Harry L. Englebright Dam. In doing so it was posthumously honoring the man who had given his support to provide the ways and means for rehabilitation of the hydraulic mining industry.

Over the next decade the Commission continued to go into the mountains and make annual inspections of the hydraulic pits. At no time during this period, however, did the number of mines licensed by the Commission exceed 25 in total nor more than seven using the debris dams for storage. By the summer of 1955, only 21 individuals held licenses from the CDC, and of those four were utilizing the dams. Over the following decade the number continued to decline until by July 1965 only eight mines were licensed of which three were using the debris dams. The trend continued, and during 1980 just a solitary individual was operating a hydraulic mine licensed by the California Debris Commission.

North Fork Dam and Reservoir (Lake Clementine) is located about five miles northeast of the city of Auburn and 40 miles northeast of Sacramento. The dam is 155 feet high and 620 feet long. The reservoir behind the dam has a debris-storage capacity of 26,000,000 cubic yards. Harry L. Englebright Dam and Reservoir is on the Yuba River about 20 miles northeast of the city of Marysville. The dam is 260 feet high and 1,142 feet long. The reservoir has a debris-storage capacity of approximately 118,000,000 cubic yards. Total federal cost of new work for construction of these dams and reservoirs was $4,646,872.

For the last four decades Englebright and North Fork Dams have, despite the early fears of some, remained unyielding barriers, wedged in the canyons of the Yuba and American Rivers. While the reservoirs behind the dams were designed to hold millions upon millions of cubic yards of mining debris, to date only a tiny fraction of this capacity has been utilized for that purpose. They have no doubt, however, held in place mining debris from an earlier time as well as detritus from natural erosion. Hence, the prayed-for panacea that was to breath new life into the prostrate giant has, in reality, had little if any effect upon gold production in the State of California. The victory, when it was finally achieved, proved to be too little too late. Political and economic conditions were so vastly different in the period after 1940 from those during the last quarter of the nineteenth century that what would have been the answer to corporate dreams only provided false hope for the dispossessed of the new century. The relative value of gold, the high cost for equipment and operations, the coming of war, the importance of Sierra waters for other than mining purposes — all of these and more made any notion of reviving the hydraulic mining industry an exercise in futility.

North Fork Dam (Corps of Engineers' photo)

Hardly had the dams been completed than their potential users came under fire from farming interests, sport-fishing enthusiasts and domestic water suppliers. Typical of this was the suit brought by the Carmichael Irrigation District against the Lost Camp Mining Company et al., claiming that their operations upstream from North Fork Dam were fouling the waters and causing them problems. The miners countered by saying that a little muddy water wouldn't hurt anybody. Needless to say this and similar cases were lost by the miners.

Even if the miners could have held the farmers, the Bureau of Fisheries and other like-minded opponents at bay, they faced a truly insoluble problem: water, or more accurately, lack of water. The majority of the water rights and a substantial portion of the ditches and flumes constructed by the hydraulickers had long since passed to other hands. Power companies, irrigation districts and municipalities had stepped into the breach caused by the Sawyer decision and had clamped an unyielding grip on the water supplies. With the old sources no longer available, the only practical answer was the construction of large storage reservoirs high in the mountains and the piping of water to the mining site. To do this required massive amounts of money, but the investors weren't to be found. Survivors of the Great Depression simply couldn't be convinced to gamble on such schemes. And even if by some mystical means the capital, technical know-how, manpower and equipment could be forged into a viable unit, the courts could — and probably would — shut off the "monitors" soon after the first blast of water hit the gravel bank. A pair of dams, no matter how well planned and constructed, could not prevail against such odds.

This is not to suggest, however, that the dams constructed by the Debris Commission have amounted to mere concrete plugs that temporarily restrict the flow of water. While it is certainly true that they have not in fact been fully utilized for their initial purpose, they have nonetheless served the people of California in other important ways. From strictly an aesthetic point of view, few manmade works found in the foothills of the Sierra are as awe-inspiring as Englebright and North Fork Dams. This is especially true during the spring months when the Yuba and American, swollen by melting snows, send freshets down their canyons to cascade over the dams. The resultant mists from these artificial waterfalls rise through the green oaks and pines to create breathtaking displays. It is difficult to picture the area before the dams were in place — they look as though they have always been a part of the environment. Moreover, Lake Clementine, behind North Fork Dam, and Englebright Lake, have for the past forty summers provided pleasant days of fishing, swimming, waterskiing and picnicking for thousands of visitors.

Since 1958 the Corps of Engineers has provided public use facilities at a cost of $367,000, and a concessionaire has invested about $131,000 to provide boating and other facilities at Englebright Lake. Finally the Pacific Gas and Electric Company and the Yuba County Water Agency pay the federal government, through the Debris Commission, for the value of falling water for power generation at Englebright.

From a purely scientific standpoint the dams have added to the overall fund of knowledge regarding dam construction. We must remember that when these barriers were put up, the electronic computer age was many years in the future. During the late 1930s design engineers were dealing with yet-to-be proven theories — especially was this the case with thin-arch dams. The dams themselves then, and their plans and specifications, have served as tools for later engineers in designing similar barriers.

While the dams will never be the final resting place for fresh hydraulic debris, their place in the overall matrix of the aesthetic and utilitarian appliances that make up the California Debris Commission's projects is secure. There is no doubt that they will be enjoyed by future generations seeking relief from the crowded habitats of the valley and coast.

Chapter VII

Epilogue

Much of the work planned and initially executed by the Commission eventually fell within the domain of the Sacramento District. This was especially true of the projects completed on the San Joaquin River and in the Delta. Such "overlapping" of responsibilities was, for the most part, the natural consequence of the greatly expanded civil works role of the District, the fact that the Secretary of the Commission was embodied in the person of the District Engineer and that, practically speaking, it would have proved to be an unnecessary duplication of functions to maintain absolutely separate administrative structures.*

Over the years several new projects have been authorized for the Sacramento and San Joaquin Rivers which have greatly enhanced navigation and brought floods on these great streams under control. Typical of these are: Sacramento River and Major and Minor Tributaries; Sacramento River Bank Protection; Sacramento River, Chico Landing to Red Bluff; Sacramento River, Red Bluff to Shasta Dam; Sacramento River Deep Water Ship Channel; and various projects for the improvement of streams tributary to the Sacramento. It must be pointed out, however, that each of these new projects rests on the foundation conceived and constructed by the California Debris Commission. And even though new authorizations have been funded apart from CDC projects, and others supplanted by District operations for the river, the original Commission project is still funded and reported upon as a separate entity. This is the Sacramento River Flood Control Project — traditionally referred to as the "Old Project."

This comprehensive project, it will be remembered, was approved as part of that signal piece of legislation known as the Flood Control Act of 1917. The truly unique features of the project were the weirs. These outlet works were built into the levees to allow the excess water to escape into the bypasses, which in and of themselves are quite rare structures. The third aspect of this part of the project is pumping plants, designed to move water about at will. All five of the weirs as proposed in the 1910 and 1917 Acts were completed prior to 1940. By that same time, the Commission had supervised a tremendous amount of levee construction and dredging — both significant aspects of the total project.

Sacramento River, bank protection work. (Corps of Engineers' photo)

During the war years the Commission continued operations, but at a much reduced rate due to the demands of the wartime economy, and the need of men and material for the prosecution of the war effort. By the summer of 1945, the flood control project was estimated to be about seventy-five percent complete.

Similarly, work on the debris structures and within the bed of the Yuba River was likewise carried out on a reduced scale. For the most part it consisted of maintaining the existing project. Minor construction was completed on the dams, and limited snagging and bank protection work was completed relative to river improvement.

Following the war, work picked up at near the normal rate. In addition to the scheduled new work, a fair amount of catching-up had to be done, particularly regarding the levees that protected the low-lying islands of the Delta. Without regular maintenance the peat embankments deteriorated quickly, and hence were in need of considerable shoring up. Among the islands protected during this period were Liberty Farms Tract, Hastings Tract, Tyler Island, Randall Island, Merritt Island, Ryer Island, and Grand Island.

By 1950 the entire project was well on its way to being completed — and well that it was. For during November and December of that year torrential rains again visited Northern California which resulted in tremendous flows coursing down the Sacramento River and its tributaries. Due to the construction work of the Commission, the Sacramento River was confined between its levees. The weirs, bypasses, floodways and natural storage basins worked beautifully and contained the vast majority of the flood. It was estimated at the time that the Sacramento River Flood Control Project prevented damages of some $75,000,000 during the period of the flood. Interestingly enough, the total expenditures for the project to that time were about $47,000,000. So, with just one major flood, the project more than paid for itself.

Things didn't go quite so well on the Yuba, however. A peak flow of some 113,000 cubic feet per second on November 21, 1950, breached the south training wall of the south channel above Daguerre Point Dam. As a result, a flow of approximately 40,000 cubic feet per second rushed through and over an area of about 3,000 acres of dredger pilings to partially flood the town of Hammonton. The water then progressed into Reclamation District No. 784, causing a disastrous flooding of

* Early political maneuvering notwithstanding.

Tisdale Weir (Corps of Engineers' photos)

the community of Olivehurst and outlying homes and farms. By going out of its banks the Yuba caused extensive damage to agricultural property, commercial and industrial installations, suburban residential property, roads, railroads and public utilities. In all, more than 43,000 acres were flooded. Damages totalled $4,000,000.

After the flood the Commission supervised repairs to Daguerre Point Dam and the nearby levees. Earlier, in 1944, the Commission had issued a permit to the Yuba Consolidated Gold Fields to dredge a 600-foot channel and put up training walls to take the place of the pair of 500-foot channels completed in 1935. Following the 1950 flood, the company began to construct the new channel, and by the summer of 1954 had completed some 35 percent of the new work.

Prior to World War II, the CDC completed work on the fish ladders at Daguerre Point Dam. (Corps of Engineers' photos)

In 1955 record floods again tested the Debris Commission's efforts. Once again the Sacramento River levees and by-passes functioned well, but the works near Marysville gave way under the strain. Just a few minutes after midnight, during the first moments of December 24, 1955, the levee protecting Yuba City burst, and before it was repaired 100,000 acres were flooded. While more than half of California was subjected to flooding, the Yuba City flood constituted the largest single disaster. Viewed statewide, the flood of December 1955 was the greatest disaster of its kind to hit California to that time. It was rated as the worst misfortune of any kind since the earthquake and fire that destroyed much of San Francisco in 1906. Thirty-eight people lost their lives, while thousands of homes and businesses were either destroyed or severely damaged in the Yuba City area. Destruction in Sutter County alone was estimated at between $35,000,000 and $40,000,000.

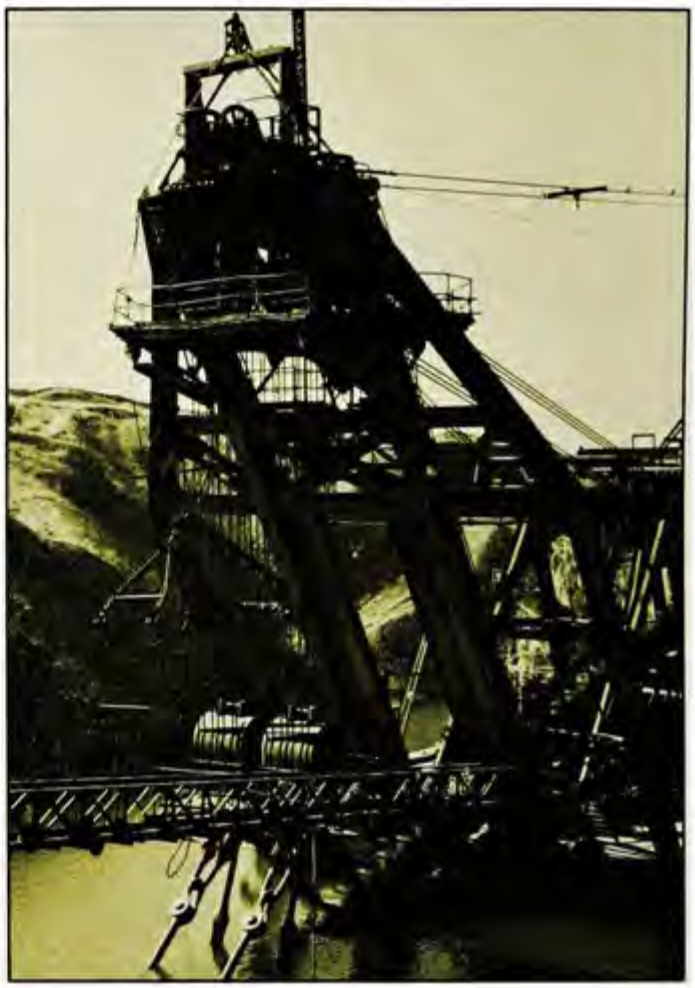
The training walls and Daguerre Point Dam were also damaged by the 1955

Workman above repairs planking on Daguerre Point Dam during the 1930s. (Corps of Engineers' photo)

Corps of Engineers crews repair levees near Yuba City following the disastrous flood of 1955. (Corps of Engineers' photos)

flood. Approximately 15,000 feet of the training walls had to be repaired along with the decking on the dam. Less than a decade later the Daguerre Point Dam was again damaged. In February 1963, the center section of the dam failed and major rehabilitation of the structure was completed in 1964. The repairs were barely completed when the dam sustained considerable damage during the heavy flooding of December 24, 1964. Permanent repairs to the facility were completed in October 1965 at a cost of $448,000.

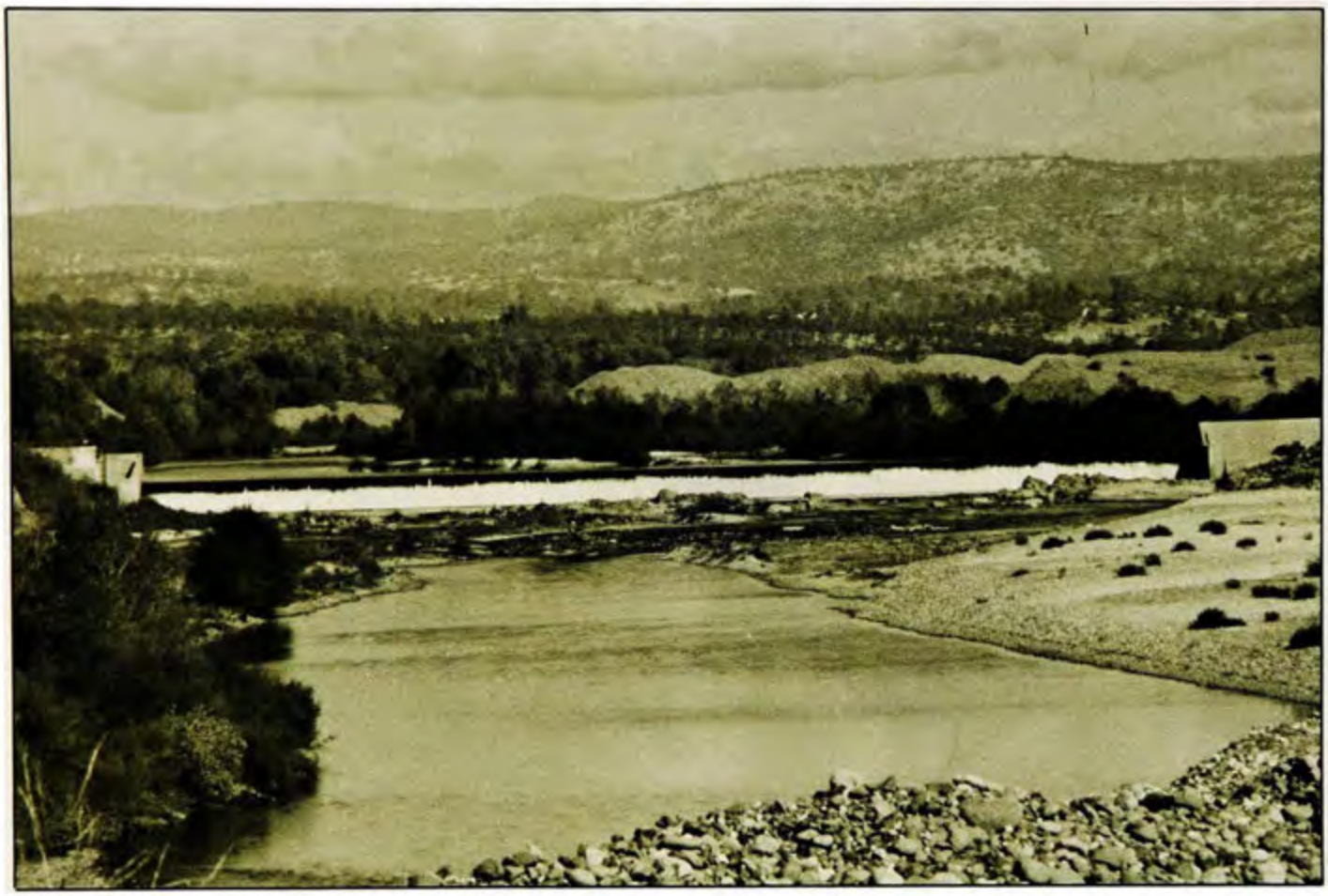
By 1970 the work authorized by the original 1910 and 1917 Acts (as modified) was considered just about complete. The only work remaining was a small amount of levee work in the Yolo Bypass and near Cache Slough.* Down the years these levees, bypasses, weirs and associated works have prevented millions of dollars in damages, and saved scores of lives. During the last decade the Commission has maintained the project to design



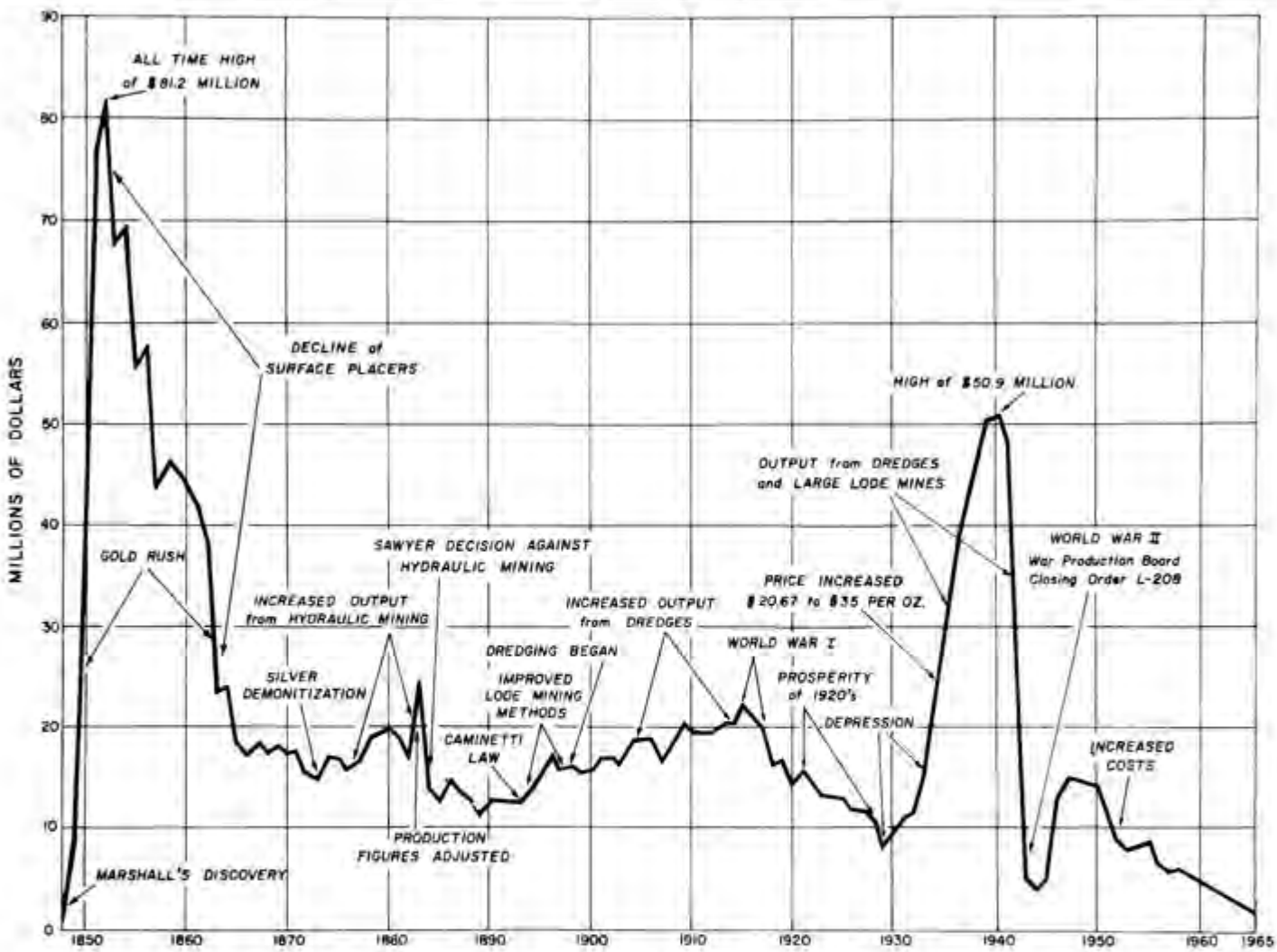
Yuba Consolidated Gold Fields dredges removed a fortune in gold from the Yuba River while they used tailings to build training walls to keep the river under control. (Author's photos)

* Estimated to be 99% complete.

Huge wagons were used to haul spare parts and equipment to the dredges to ensure that operations continued on the Yuba River. (Author's photos)



Daguerre Point Dam, 1980. (Author's photos)



Gold Production in California, 1848–1965.

specifications, and has worked to make the "Old Project" function as an integral part of the general flood control plan for the entire valley.

As we enter upon the decade of the 1980s the California Debris Commission can look back with pride over years of innovation, hard work and dedicated service. Even though the work of the Commission did not restore hydraulic mining to the place it once held, many other significant projects were completed that have brought peace of mind, protection and prosperity to millions of Californians. Since 1935, when the Daguerre Point Dam was completed, more than 140 million cubic yards of mining debris have been held in check and not allowed to clog the channels of the Sacramento River. On and about that great river almost a thousand miles of levees have been constructed to spare the farms and cities the agony of destructive floods. Within the channel of the Sacramento, millions of yards of material have been dredged, allowing flood waters, and commercial navigation, to move easily through the valley.

During the nearly 100 years the Commission has been in existence it has received some 1,300 applications to mine by the hydraulic method. In 1980 only a single permit remained active. Looking back it seems just a bit ironic that when Colonel Mendell organized the Commission on May 16, 1893, he did so in the **Flood Building** on Market Street, in downtown San Francisco.

Concurrently with the publication of this history, the Sacramento District has proposed the abolishment of the California Debris Commission, with all its duties transferred to the Department of the Army, acting under the Secretary of the Army and supervision of the Chief of Engineers. This agency has in fact been administering the remaining duties for several years. It will take an Act of Congress to formally consummate the transfer.

APPENDIX A

AN ACT TO CREATE THE CALIFORNIA DEBRIS COMMISSION AND REGULATE HYDRAULIC MINING IN THE STATE OF CALIFORNIA,

AS AMENDED TO JANUARY 1, 1938

California Debris Commission created.

Appointment.

Authority and power.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That a commission is hereby created, to be known as the California Debris Commission, consisting of three members. The President of the United States shall, by and with the advice and consent of the Senate, appoint the commission from officers of the Corps of Engineers, United States Army. Vacancies occurring therein shall be filled in like manner. It shall have the authority, and exercise the powers hereinafter set forth, under the supervision of the Chief of Engineers and direction of the Secretary of War.

Organization.

Compensation.

Rules, etc., of procedure.

SEC. 2. That said commission shall organize within thirty days after its appointment by the selection of such officers as may be required in the performance of its duties, the same to be selected from the members thereof. The members of said commission shall receive no greater compensation than is now allowed by law to each, respectively, as an officer of said Corps of Engineers. It shall also adopt rules and regulations, not inconsistent with law, to govern its deliberations and prescribe the method of procedure under the provisions of this act.

Jurisdiction.

Injurious hydraulic mining prohibited.

SEC. 3. That the jurisdiction of said commission, in so far as the same affects mining carried on by the hydraulic process shall extend to all such mining in the territory drained by the Sacramento and San Joaquin river systems in the State of California. Hydraulic mining, as defined in section eight hereof, directly or indirectly injuring the navigability of said river systems, carried on in said territory other than as permitted under the provisions of this act is hereby prohibited and declared unlawful.

Duty of commission.

Plans.

Improving navigability of rivers, etc.

Certain hydraulic mining permitted.

SEC. 4. That it shall be the duty of said commission to mature and adopt such plan or plans, from examinations and surveys already made and from such additional examinations and surveys as it may deem necessary, as will improve the navigability of all the rivers comprising said systems, deepen their channels, and protect their banks. Such plan or plans shall be matured with a view of making the same effective as against the encroachment of and damage from debris resulting from mining operations, natural erosion, or other causes, with a view of restoring, as near as practicable and the necessities of commerce and navigation demand the navigability of said rivers to the condition existing in eighteen hundred and sixty, and permitting mining by the hydraulic process, as the term is understood in said state, to be carried on, provided the same can be accomplished without injury to the navigability of said rivers and the lands adjacent thereto.

Surveys of storage sites for debris, reservoirs, etc.

Examination of hydraulic and other mines, etc.

SEC. 5. That it shall further examine, survey and determine the utility and practicability, for the purposes hereinafter indicated, of storage sites in the tributaries of said rivers and in the respective branches of said tributaries, or in the plains, basins, sloughs, and tule and swamp lands adjacent to or along the course of said rivers, for the storage of debris or water or as settling reservoirs, with the object of using the same by either or all of these methods to aid in the improvement and protection of said navigable rivers by preventing deposits therein of debris resulting from mining operations, natural erosion, or other causes, or for affording relief thereto in flood time and providing sufficient water to maintain scouring force therein in the summer season; and in connection therewith to investigate such hydraulic and other mines as are now or may have been worked by methods intended to restrain the debris and material moved in operating such mines by impounding dams, settling reservoirs, or otherwise, and in general to make such study of and researches in the hydraulic mining industry as science, experience and engineering skill may suggest as practicable and useful in devising a method or methods whereby such mining may be carried on as aforesaid.

Noting conditions of navigable channels.

SEC. 6. That the said commission shall from time to time note the conditions of the navigable channels of said river systems, by cross-section surveys or otherwise, in order to ascertain the effect therein of such hydraulic mining operations as may be permitted by its orders and such as is caused by erosion, natural or otherwise.

Annual report.

Contents.

SEC. 7. That said commission shall submit to the Chief of Engineers, for the information of the Secretary of War, on or before the fifteenth day of November of each year a report of its labors and transactions, with plans for the construction, completion, and preservation of the public works outlined in this act, together with estimates of the cost thereof, stating what amounts can be profitably expended thereon each year. The Secretary of War shall thereupon submit same to Congress on or before the meeting thereof.

"Hydraulic mining" and "mining by the hydraulic process" defined.

SEC. 8. That for the purposes of this act "hydraulic mining" and "mining by the hydraulic process" are hereby declared to have the meaning and application given to said terms in said State.

Hydraulic miners must file petition with commission.

SEC. 9. That the individual proprietor or proprietors or in case of a corporation its manager or agent appointed for that purpose, owning mining ground in the territory in the State of California mentioned in section three hereof, which it is desired to work by the hydraulic process, must file with said commission a verified petition, setting forth such facts as will comply with law and the rules prescribed by said commission.

Surrender to United States of right to regulate the working, etc.

??? of other processes, etc., not affected.

Proviso. Navigability of rivers.

SEC. 10. That said petition shall be accompanied by an instrument duly executed and acknowledged, as required by the law of the said State, whereby the owner or owners of such mine or mines surrender to the United States the right and privilege to regulate by law, as provided in this act, or any law that may hereafter be enacted, or by such rules and regulations as may be prescribed by virtue thereof the manner and method in which the debris resulting from the working of said mine or mines shall be restrained, and what amount shall be produced therefrom; it being understood that the surrender aforesaid shall not be construed as in any way affecting the right of such owner or owners to operate said mine or mines by any other process or method now in use in said State: **Provided,** That they shall not interfere with the navigability of the aforesaid rivers.

Joint petition by mining claim owners requiring a common dumping ground, etc.

SEC. 11. That the owners of several mining claims situated so as to require a common dumping ground or dam or other restraining works for the debris issuing therefrom in one or more sites may file a joint petition setting forth such facts in addition to the requirements of section nine hereof; and where the owner of a hydraulic mine or owners of several such mines have and use common dumping sites for impounding debris or as settling reservoirs which sites are located below the mine of an applicant not entitled to use same, such fact shall also be stated in said petition. Thereupon the same proceedings shall be had as provided for herein.

Notice of petition, etc., to be published.

Examination pending publication.

Affidavits, plans, etc., may be filed. Hearings.

SEC. 12. A notice specifying briefly the contents of said petition and fixing a time previous to which all proofs are to be submitted shall be published by the commission in some newspaper or newspapers of general circulation in the communities interested in the matter set forth therein. If published in a daily paper such publication shall continue for at least ten days; if in a weekly paper in at least three issues of the same. Pending publication thereof, said commission, or a committee thereof, shall examine the mine and premises described in such petition. On or before the time so fixed all parties interested, either as petitioners or contestants, whether miners or agriculturists, may file affidavits, plans, and maps in support of their respective claims. Further hearings, upon notice to all parties of record, may be granted by the commission when necessary.

Favorable decisions within thirty days.
Order directing methods of mining conditions, etc.

Taxes on gross proceeds. **Proviso.** Expenses

SEC. 13. That in case a majority of the members of said commission, within thirty days after the time so fixed, concur in a decision in favor of the petitioner or petitioners, the said commission shall thereupon make an order directing the methods and specifying in detail the manner in which operations shall proceed in such mine or mines; what restraining or impounding works, if facilities therefor can be found, shall be built, and maintained; how and of what material; where to be located; and in general set forth such further requirements and safeguards as will protect the public interests and prevent injury to the said navigable rivers, and the lands adjacent thereto, with such further conditions and limitations as will observe all the provisions of this act in relation to the working thereof and the payment of taxes on the gross proceeds of the same: **Provided,** That all expense incurred in complying with said order shall be borne by the owner or owners of such mine or mines.

Plans, etc., to be submitted to commission.
Commencement of works. Supervision and inspection. Completion of works.

Permission to commence mining.

SEC. 14. That such petitioner or petitioners must within a reasonable time present plans and specifications of all works required to be built in pursuance of said order for examination, correction, and approval by said commission; and thereupon work may immediately commence thereon under the supervision of said commission or representative thereof attached thereto from said Corps of Engineers, who shall inspect same from time to time. Upon completion thereof, if found in every respect to meet the requirements of the said order and said approved plans and specifications, permission shall thereupon be granted to the owner or owners of such mine or mines to commence mining operations, subject to the conditions of said order and the provisions of this act.

Conditions, etc., as to commencing operations.

Proviso. Navigation, etc., sufficiently protected.

SEC. 15. That no permission granted to a mine owner or owners under this act shall take effect, so far as regards the working of a mine, until all impounding dams or other restraining works, if any are prescribed by the order granting such permission, have been completed, and until the impounding dams or other restraining works or settling reservoirs provided by said commission have reached such a stage as in the opinion of said commission, it is safe to use the same: **Provided, however,** That if said commission shall be of the opinion that the restraining and other works already constructed at the mine or mines shall be sufficient to protect the navigable rivers of said systems and the work of said commission, then the owner or owners of such mine or mines may be permitted to commence operations.

Allotment of expenses for constructing common dumps, etc.

Subsequent petitioners to pay for dumping privilege. Apportionment of such payment to original owners. maintenance, etc.

Location.

SEC. 16. That in case the joint petition referred to in section eleven hereof is granted, the commission shall fix the respective amounts to be paid by each owner of such mines toward providing and building necessary impounding dams or other restraining work. In the event of a petition being filed after the entry of such order or in case the impounding dam or dams or other restraining works have already been constructed and accepted by said commission, the commission shall fix such amount as may be reasonable for the privilege of dumping therein, which amount shall be divided between the original owners of such impounding dams or other restraining works in proportion to the amount respectively paid by each party owning same. The expense of maintaining and protecting such joint dam or works shall be divided among mine owners using the same in such proportion as the commission shall determine. In all cases where it is practicable, restraining and impounding works are to be provided, constructed and maintained by mine owners near or below the mine or mines before reaching the main tributaries of said navigable waters.

Limit of debris washed away.

SEC. 17. That at no time shall any more debris be permitted to be washed away from any hydraulic mine or mines situated on the tributaries of said rivers and the respective branches of each, worked under the provisions of this act, than can be impounded within the restraining works erected.

Specification, etc., of orders.

SEC. 18. That the said commission may at any time when the condition of the navigable rivers or when the capacities of all impounding and settling facilities erected by mine owners or such as may be provided by Government authority require same, modify the order granting the privilege to mine by the hydraulic mining process so as to reduce amount thereof to meet the capacities of the facilities then in use, or, if actually required in order to protect the navigable rivers from damage, may revoke same until the further notice of the commission.

Forfeiture for violating conditions.

Work to cease upon service of notice.
Enforcement of orders, etc.

SEC. 19. That an intentional violation on the part of a mine owner or owners, company, or corporation, or the agents or the employees of either, of the conditions of the order granted pursuant to section thirteen or such modifications thereof as may have been made by said commission, shall work a forfeiture of the privileges thereby conferred, and upon notice being served by the order of said commission upon such owner or owners, company or corporation, or agent in charge, work shall immediately cease. Said commission shall take necessary steps to enforce its orders in cases of the failure, neglect, or refusal of such owner or owners, company, or corporation, or agents thereof, to comply therewith, or in the event of any person or persons, company or corporation working by said process in said territory contrary to law.

Visiting mines.

Report.

SEC. 20. That said commission, or a committee therefrom or officer of said corps assigned to duty under its orders, shall, whenever deemed necessary, visit said territory and all mines operating under the provisions of this act. A report of such examination shall be placed on file.

Use of public lands and material.

Withdrawal of lands from sale and entry.

SEC. 21. That the said commission is hereby granted the right to use any of the public lands of the United States, or any rock, stone, timber, trees, brush, or material thereon or therein, for any of the purposes of this act; and the Secretary of the Interior is hereby authorized and requested, after notice has been filed with the Commissioner of the General Land Office by said commission, setting forth what public lands are required by it under the authority of this section, that such land or lands shall be withdrawn from sale and entry under the laws of the United States.

Willful injury to works a misdemeanor.

Penalty.

Violation of this act a misdemeanor.

Penalty.

Proviso.

Operative date.

SEC. 22. That any person or persons who willfully or maliciously injure, damage, or destroy, or attempt to injure, damage, or destroy, any dam or other work erected under the provisions of this act for restraining, impounding, or settling purposes, or for use in connection therewith, shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not to exceed the sum of five thousand dollars or be imprisoned not to exceed five years, or by both such fine and imprisonment, in the discretion of the court. And any person or persons, company or corporation, their agents or employees, who shall mine by the hydraulic waters of the United States, in violation of the provisions of this act shall be guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine not exceeding five thousand dollars, or by imprisonment not exceeding one year, or by both such fine and imprisonment, in the discretion of the court: **Provided,** That this section shall take effect on the first day of May, eighteen hundred and ninety-three.

Tax on gross proceeds of hydraulic mines.

Ascertainment and payment of tax.

Regulations, etc.

A "Debris Fund" created. Expenditures from same by the commission.

Proviso.

Money advances from mine owners.

Refund of same when tax is paid.

SEC. 23. That upon the construction by the said commission of dams or other works for the detention of debris from hydraulic mines and the issuing of the order provided for by this act to any individual, company, or corporation to work any mine or mines by hydraulic process, the individual, company, or corporation operating thereunder working any mine or mines by hydraulic process, the debris from which flows into or is in whole or in part restrained by such dams or other works erected by said commission, shall pay a tax of three per centum on the gross proceeds of his, their, or its mine so worked; which tax of three per centum shall be ascertained and paid in accordance with regulations to be adopted by the Secretary of the Treasury, and the Treasurer of the United States is hereby authorized to receive the same. All sums of money paid into the Treasury under this section shall be set apart and credited to a fund to be known as the "Debris Fund," and shall be expended by said commission under the supervision of the Chief of Engineers and direction of the Secretary of War, in addition to the appropriations made by law in the construction and maintenance of such restraining works and settling reservoirs as may be proper and necessary: **Provided,** That said commission is hereby authorized to receive and pay into the Treasury from the owner or owners of mines worked by the hydraulic process, to whom permission may have been granted so to work under the provisions thereof, such money advances as may be offered to aid in the construction of such impounding dams or other restraining works, or settling reservoirs, or sites therefor, as may be deemed necessary by said commission to protect the navigable channels of said river systems, on condition that all moneys so advanced shall be refunded as the said tax is paid into the said debris fund: **And provided further,** That in no event shall the Government of the United States be held liable to refund same except as directed by this section.

Commission may consult with State commission of engineers.

Report on conference. Approval.

SEC. 24. That for the purpose of securing harmony of action and economy of expenditures in the work to be done by the United States and the State of California, respectively, the former in its plans for the improvement and protection of the navigable streams and to prevent the depositing of mining debris or other materials within the same, and the latter in its plans authorized by law for the reclamation, drainage, and protection of its lands, or relating to the working of hydraulic mines, the said commission is empowered to consult thereon with a commission of engineers of said State, if authorized by said State for said purpose, the result of such conference to be reported to the Chief of Engineers of the United States Army, and if by him approved shall be followed by said commission.

Appropriations from debris fund to be expended in restraining works, etc., above head of navigation, etc.

SEC. 25. That said commission, in order that such material as is now or may hereafter be lodged in the tributaries of the Sacramento and San Joaquin River systems resulting from mining operations, natural erosion, or other causes, shall be prevented from injuring the said navigable rivers or such of the tributaries of either as may be navigable and the land adjacent thereto, is hereby directed and empowered, when appropriations are made therefor by law, or sufficient money is deposited for that purpose in said debris fund, to build at such points above the head of navigation in said rivers and on the main tributaries thereof, or branches of such tributaries, or at any place adjacent to the same, which in the judgment of said commission will effect said object (the same to be of such

Recommendations adopted and made the basis of operations.

Appropriations.

material as will insure safety and permanency), such restraining or impounding dams and settling reservoirs, with such canals, locks, or other works adapted and required to comlete same. The recommendations contained in Executive Document Numbered Two Hundred and Sixty-seven, Fifty-first Congress, second session, and Executive Document Numbered Ninety-eight, Forty-seventh Congress, First session, as far as they refer to impounding dams, or other restraining works are hereby adopted, and the same are directed to be made the basis of operations. The sum of fifteen thousand dollars is hereby appropriated, from moneys in the Treasury not otherwise appropriated, to be immediately available to defray the expenses of said Commission.

Approved, March 1, 1893.

Feb. 27, 1907, **Vol. 34, p. 1001.**. (H.R. 13367.) (Public No. 137.)

California Debris Commission. Vol. 27, p. 508. Ante, p. 661.

CHAP. 2077. An Act To amend section thirteen of an Act of March first, eighteen hundred and ninety-three, entitled "An Act to create the California Debris Commission and regulate hydraulic mining in the State of California."

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section thirteen of an Act of March first, eighteen hundred and ninety-three, entitled "An Act to create the California Debris Commission and to regulate mining in the State of California," is hereby amended so as to read as follows:

Favorable decisions within 30 days. Order directing methods of mining, etc.

"SEC. 13. That in case a majority of the members of said Commission, within thirty days after the time so fixed, concur in the decision in favor of the petitioner or petitioners, the said Commission shall thereupon make an order directing the methods and specifying in detail the manner in which operations shall proceed in such mine or mines; what restraining or impounding works, if any, if facilities therefor can be found, shall be built and maintained; how and of what material; where to be located; and in general set forth such further requirements and safeguards as will protect the public interests and prevent injury to the said navigable rivers and the lands adjacent thereto, with such further conditions and limitations as will observe all the provisions of this Act in relation to the working thereof and the payment of taxes on the gross proceeds of the same; **Provisos.** That all expenses incurred in complying with said order shall be borne by the owner or owners of such mine or mines; **And provided further,** That where it shall appear to said Commission that hydraulic mining may be carried on without injury to the navigation of said navigable rivers and the lands adjacent thereto, an order may be made authorizing such mining to be carried on without requring the construction of any restraining or impounding works or any settling reservoirs; **And provided also,** That where such an order is made a license to mine, no taxes provided for herein on the gross proceeds of such mining operations shall be collected.

Taxes on gross proceeds.

Provisos. Expenses.

Hydraulic mining without impounding works, etc.

No tax on gross proceeds to be collected.

Approved, February 27, 1907.

(Public No. 425 — 73d Congress) (H.R. 1503.)

An Act To amend the Act, entitled "An Act to create the California Debris Commission and regulate hydraulic mining in the State of California", approved March 1, 1893, as amended.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 18 of the Act entitled "An Act to create the California Debris Commission and regulate hydraulic mining in the State of California" approved March 1, 1893, as amended (U.S.C., title 33, sec. 678), is amended to read as follows:

"SEC 18. The said commission may, at any time when the condition of the navigable rivers or when the capacities of all impounding and settling facilities erected by mine owners or such as may be provided by Government authority require same, modify the order granting the privilege to mine by the hydraulic mining process so as to reduce the amount thereof to meet the capacities of the facilities then in use; or, if actually required in order to protect the navigable rivers from damage or in case of failure to pay the tax prescribed by section 23 hereof within thirty days after same becomes due, may revoke same until the further notice of the commission."

SEC. 2. Section 23 of such Act as amended (U.S.C., title 33, sec. 683), is amended to read as follows.

"SEC. 23. Upon the construction by the said commission of dams or other works for the detention of debris from hydraulic mines and the issuing of the order provided for by this Act to any individual, company, or corporation to work any mine or mines by hydraulic process, the individual company, or corporation operating thereunder working any mine or mines by hydraulic process, the debris from which flows into or is in whole or in part restrained by such dams or other works erected by said commission, shall pay for each cubic yard mined from the natural bank a tax equal to the total capital cost of the dam, reservoir, and rights of way divided by the total capacity of the reservoir for the restraint of debris, as determined in each case by the California Debris Commssion, which tax shall be paid annually on a date fixed by said commission and in accordance with regulations to be adopted by the Secretary of the Treasury, and the Treasurer of the United States is hereby authorized to receive the same. All sums of money paid into the Treasury under this section shall be set apart and credited to a fund to be known as the debris fund, and shall be expended by said commission under the supervision of the Chief of Engineers and direction of the Secretary of War, for repayment of any funds advanced by the Federal Government or other agency for the construction of restraining works and settling reservoirs, and for maintenance: **Provided**, That said commission is hereby authorized to receive and pay into the Treasury from the owner or owners of mines worked by the hydraulic process, to whom permission may have been granted so to work under the provisions thereof, such money advances as may be offered to aid in the construction of such impounding dams, or other restraining works, or settling reservoirs, or sites therefor, as may be deemed necessary by said commission to protect the navigable channels of said river systems, on condition that all moneys so advanced shall be refunded as the said tax is paid into the said debris fund: **And provided further,** That in no event shall the Government of the United States be held liable to refund same except as directed by this section."

Approved, June 19, 1934.

NOTE: In 1938 the Act was amended further when the following provision was added:

June 25, 1938

Added at the end of sec. 23 of above act, a provision that the Secretary of the Army is authorized to enter into contracts to supply storage for water and use of outlet facilities from debris storage reservoirs for domestic and irrigation purposes and power development, upon such conditions of delivery, use, and payment as he may approve, these payments are to be deposited to the credit of such reservoir project, reducing its capital cost to be repaid by tax on mining operations.

(Public No. 716, 75th Cong., 3d sess. (H.R. 9881)

APPENDIX B

CALIFORNIA DEBRIS COMMISSION SPECIFICATIONS FOR IMPOUNDING WORKS

For Log Crib Dams

1. The bottom and sides of the dam are to be founded on bed rock, and the ends of the timbers set into bed rock wherever practicable, so as to provide a shoulder against which the dam may rest, to resist the pressure of the debris when impounded.
2. The dam will consist of a downstream and an upstream wall of logs, connected by cross logs running up and down stream, the walls of cross logs to be not more than 16 feet apart.
3. All logs are to be as large as practicable, and to be well notched and driftbolted together at crossings.
4. The distance between the upstream and downstream walls of logs is to be not less than one-half the proposed finished height of dam, and in no case less than 15 feet.
5. The upstream wall is to be vertical, and the downstream wall is to have a slight slope upstream of about 1 foot in every 10 feet in height.
6. The spaces between the logs in the downstream wall are to be closed by small logs, laid inside the dam, or by brush.
7. The dam is then to be filled with stone and chinked with fine brush, leaves, etc., so that it will maintain a pool of water, while mining is in progress, at least 2 feet deep.

For Brush Dams

1. Brush dams should be built of live strong brush at least 10 feet long. All large limbs should be hacked with an axe, but not cut off, and then bent back to lie compactly. Small twigs and leaves should be left on. The poles used should not be less than 4 inches in diameter and not over 12 inches. The poles should be well trimmed and as long as practicable.
2. The dam should be built along a straight line, as follows: Level off the foundation. On this lay the brush closely with the butts in a line and pointed downstream. This should make a thick compact layer. On the top of this layer, and at right angles to the brush, lay a pole about 2 feet back from the ends of the butts, which, with other poles like it, should extend entirely across the stream.
3. A layer of gravel or small stones is then placed on the layer of brush as high as the thickness of the pole. On this layer of gravel place another heavy, compact layer of brush as before, butts downstream and tips upstream, on which lay another row of poles across the stream Then place another layer of gravel as before, and so continue until the dam is of the required height. The dam should then consist of alternate thick layers of brush and thin layers of gravel, each two layers of brush separated by a row of poles.
4. The poles should be so placed that each row of poles is somewhat back of the row below, so that the whole downstream face of the dam when completed will have a slope of about 3 horizontal to 4 vertical, and so that the butts of the brush will be about 2 feet higher than the tips. Each row of poles should be strongly wired every 4 feet to the row of poles below.
5. The dam must be tightened against leakage with gravel and fine brush thrown on the tips of the brush, so that when the mine is being worked a pool of water at least 2 feet deep will be always maintained.

(Appendix ZZ, Report of the Commission for 1904.)

Appendix C

EXCERPT FROM REPORT OF 1913 REGARDING DREDGE TENDER *RIO VISTA* AND RELATED CONSTRUCTION

Motor dredge tender 'Rio Vista.' — On November 26, 1912, proposals were invited for the construction of motor dredge tender **Rio Vista,** for use in connection with dredges **Sacramento** and **San Joaquin.** The proposals were opened on December 16, 1912. The proposal of Nunes Bros., of Sacramento, Cal., for constructing the hull of the dredge tender was accepted, and a contract therefor was entered into on December 31, 1912. This contract was nearing completion at the end of the year.

The proposal of the Atlas Gas Engine Co., of Oakland, Cal., for furnishing and installing the engines and accessories in the hull of the dredge tender was accepted, and a contract therefor was entered into December 31, 1912. This contract was nearing completion at the end of the year.

Storehouse and mooring grounds at Rio Vista. — For carrying on the operations under this project a storehouse is necessary. In former years U.S. snag boat **Seizer** and other floating plant belonging to the Sacramento River work were moored, when out of commission, along the waterfront at Sacramento. This waterfront having become crowded with river craft, it became necessary to moor the Government plant referred to when out of commission elsewhere. Rio Vista was selected as the most suitable location for this purpose. In addition to being convenient for all the Sacramento River work, it is also centrally located for the San Joaquin and Mokelumne River work. To meet the requirements of all these works a storehouse and wharf was constructed and mooring grounds prepared by hired labor at Rio Vista during the past year, the cost being defrayed from the appropriations properly chargeable therewith. This wharf is 120 feet long by 44 feet wide, including the space occupied by the storehouse, which latter is 56 feet long by 26 feet wide.

(Appendix ZZ, Report of the Commission for 1913.)

Appendix D

WING DAMS ON THE FEATHER RIVER

Inasmuch as no offer in response to the call for bids was made for the work on Feather River, L.J. Leconte, assistant engineer, was sent to Marysville to advise with parties interested in the navigation and to solicit propositions.

The amount of work to be done was not enough to justify the outfit of a party by the United States as an economical measure.

The result of this action was an offer from Mr. Rideout, engaged in navigating the river, to remove snags at the rate of $50 and to build brush dams for $1.30 per linear foot. This was the lowest offer made, and it was very reasonable.

The work was completed in October. Twenty-four snags were removed and 1,820 linear feet of brush dam were built. These operations were very much embarrassed, as were those on the Sacramento, by the prevalence of miasmatic fever, which broke up the laboring parties at intervals of a couple of weeks. This will always be a serious difficulty in these river improvements during the summer season.

The snags were extracted as required along the river. The dams were built at three points, viz: Lutte's Ranch, Whisky Chute, and just below Marysville.

The object of these brush dams was to narrow the channel and confine the current. They had the desired effect very promptly, and in a few hours a decided increase of depth was obtained. The riverbed is a fine detritus resulting from the hydraulic mining operations, and it yields readily to a slight increment in the current velocity.

The following description of these dams will be readily understood in connection with the accompanying perspective view. They were carried only to the height of the summer stage of the river in order that they should not be obstructions in the higher stages. The construction was this: Horses made of pieces of timber or small trees, 6 inches in diameter and 8 or 10 feet long, were placed 5 feet apart along the line of the dam. The legs of the horses were of length to give a slope of 35° to 40°. The horses were connected by poles, 2 inches in diameter, laid longitudinally and securely lashed to the frames. Brush having been accumulated in sufficient quantity, it was loaded on a scow and placed rapidly in a thin layer along the whole length of the dam, the brush-ends upstream. The object of covering the whole line at once was to prevent scour. Afterward other layers were added, the butt ends being placed over the horses and poles, the whole well trampled down, and loaded with gravel, or bags of sand where gravel was wanting. These dams as built were placed to secure a temporary and special result, which was accomplished doubtless at the cost of new deposits below, which, however, did not at the time obstruct navigation. It remains to be seen how much permanent benefit to the river has been secured. This point will be investigated when the river reaches its low stage.

These desultory operations are doubtless of special and temporary benefit, but they are unsatisfactory in that they are temporary and do not look to a permanent improvement in accordance with a well-considered plan.

It has been stated in a previous report that the pools in the Feather River have been filled, since the advent of the miners, 20 feet or more, so that now the bed of the river has been raised almost to the level of its banks. The mining operations not only continue to exist, but their magnitude grows under the application of new and tremendous appliances.

The rivers of the Upper Sierra are now incased and being incased in wrought-iron pipes, and are now discharged, with the velocity due to hundreds of feet preserved, against mountains of gravel.

The hills may also be said to melt away under these enormous blows. Their elements are hurled from their altitudes by a resistless current, and are borne along to find resting places in the drainage lines of the country, on the adjacent plains, or in the tidal waters of San Francisco Bay. The natural erosive forces of streams are reenforced largely by these artificial torrents.

It must be plain that under these circumstances the conservation of navigable channels becomes a problem of great magnitude and of special difficulty. It cannot be solved by building a wing dam where a shoal makes this year or next. If it and kindred problems of carrying safely the flood waters can be solved at all, they must be solved by first acquiring a thorough knowledge of all the physical facts and conditions, by a complete diagnosis. This done, the remedy, if one exists, may be discovered.

These considerations seem to require on the part of the state or of the United States an extended investigation into the physical condition of the Sacramento River, and, in a less degree, perhaps, of the San Joaquin, in connection with the extensive mining operations. These questions already begin to assume prominence in California in the shape of a conflict between its two most important interests, mining and agriculture.

It is believed that the sum of $20,000 could be well applied in the survey of these rivers and in the investigation of the problem of disposing in the least injurious way of the acres and, indeed, square miles of continent which are now moving, and which for the future will move in increasing degree, from the altitudes of the mountains to resting places on the plains or elsewhere.

(Annual Report of the Chief of Engineers, 1876)

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