

# **THREE SOUTHERN CALIFORNIA GEOLOGISTS WHO WERE PIONEERS IN ENGINEERING GEOLOGY**

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**for**

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# F. Leslie Ransome (1868-1935)



- **Francis Leslie Ransome** was born in Greenwich, England in December 1868 and his family emigrated to San Francisco two years later.
- He grew up in Oakland and attended the **University of California**, graduating in geology in **1893**.
- He continued his studies working in Marin County under Andrew Lawson, receiving his **Ph.D. in 1896**.
- That same year, he was hired by the **U.S. Geological Survey** as **one of their first four civil service professionals** (the others being W.C. Mendenhall, G.O. Smith, and A.C. Spencer).



# Ransome's USGS career

- Ransome's career at the USGS focused on economic and applied geology, assessing the continent's richest ore bodies and mining districts in a series of comprehensive reports, bulletins, and folios.
- He was one of the founding fathers of the journal *Economic Geology* in 1905, writing the memorable article "The present standing of Applied Geology," which appeared in the inaugural issue.
- The following year he authored a seminal article titled "The directions and movement and the nomenclature of faults," followed by an invited article in National geographic about the causes of the 1906 San Francisco Earthquake.
- A noted spokesperson for the geology profession, he was elected to the National Academy of Sciences in 1916.

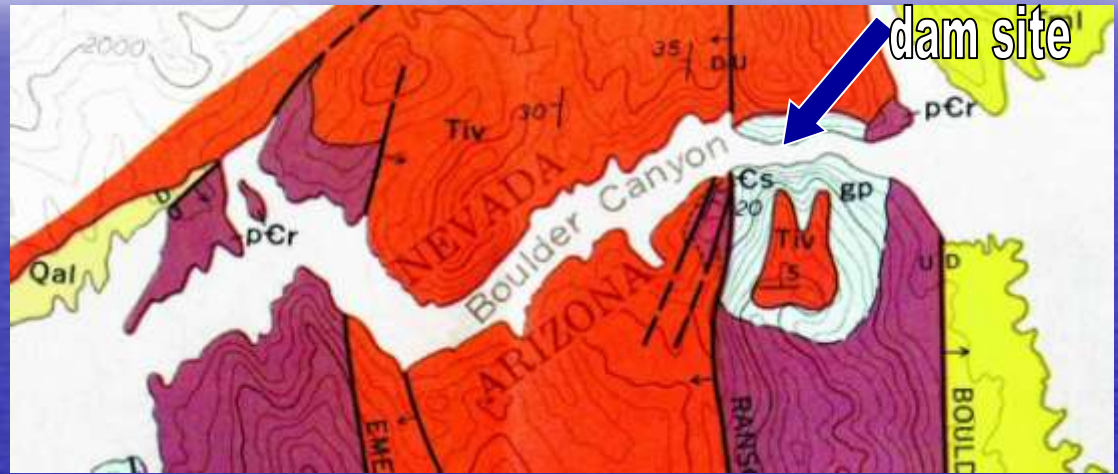
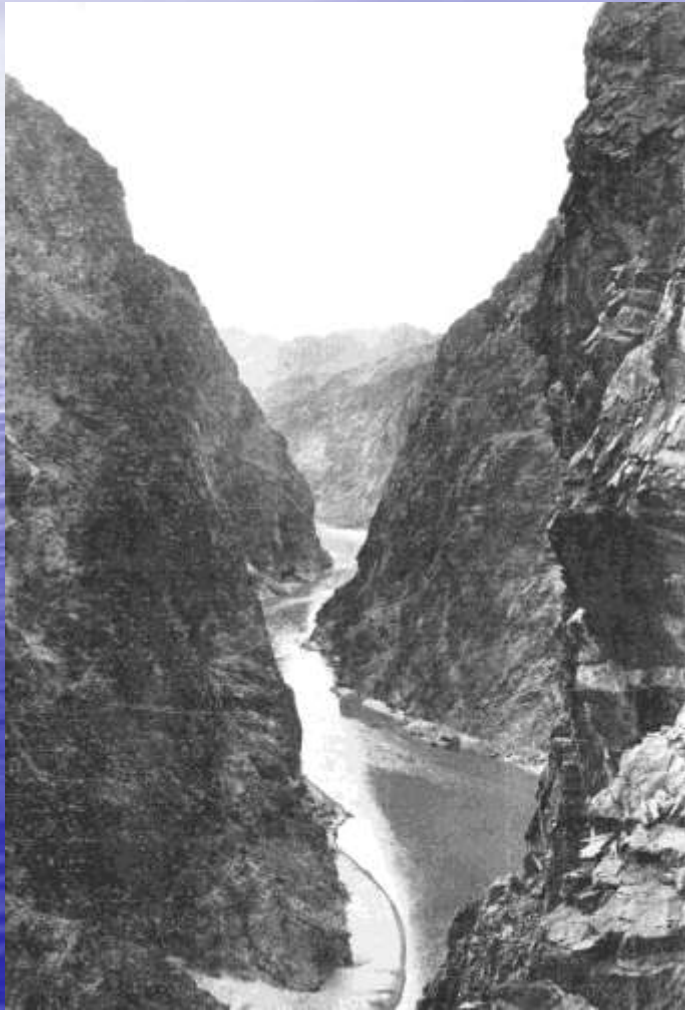




# Transition to academic career: Arizona to Caltech

- In the fall of 1922 Ransome retired from the USGS to accept a professorship in economic geology at the **University of Arizona**, where he became dean of the graduate school
- While serving as dean he hired, among others, **William Morris Davis**, to teach geomorphology.
- After refusing to sign a petition against the university president who hired him, he left Arizona to accept a half-time position as **Professor of Economic Geology** in the new geology program at the **California Institute of Technology** in Pasadena, beginning in the fall of 1927.

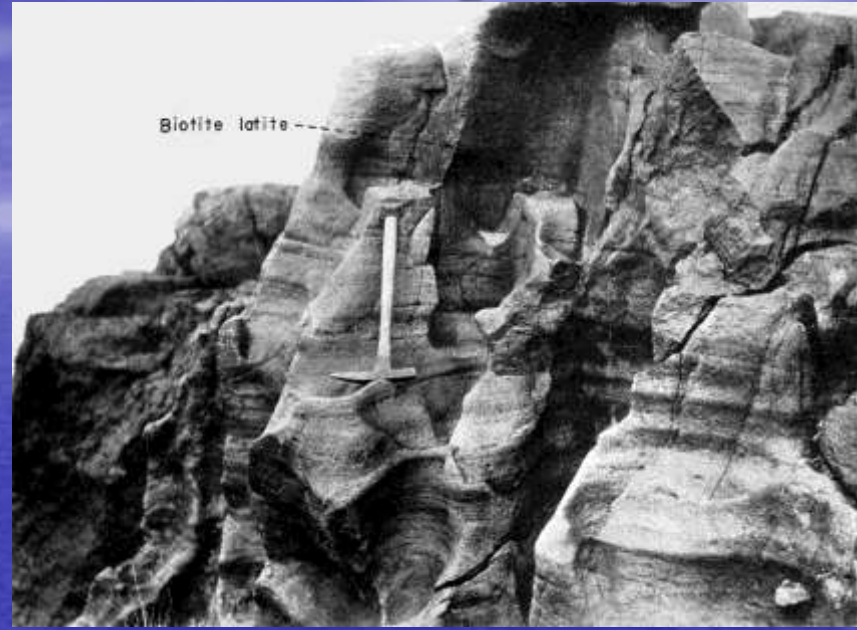
# In 1923 the Bureau of Reclamation began engaging Ransome as a geological consultant on the Boulder Canyon Project



Ransome's attention was split between the Bureau's dam sites in Boulder and Black Canyons.

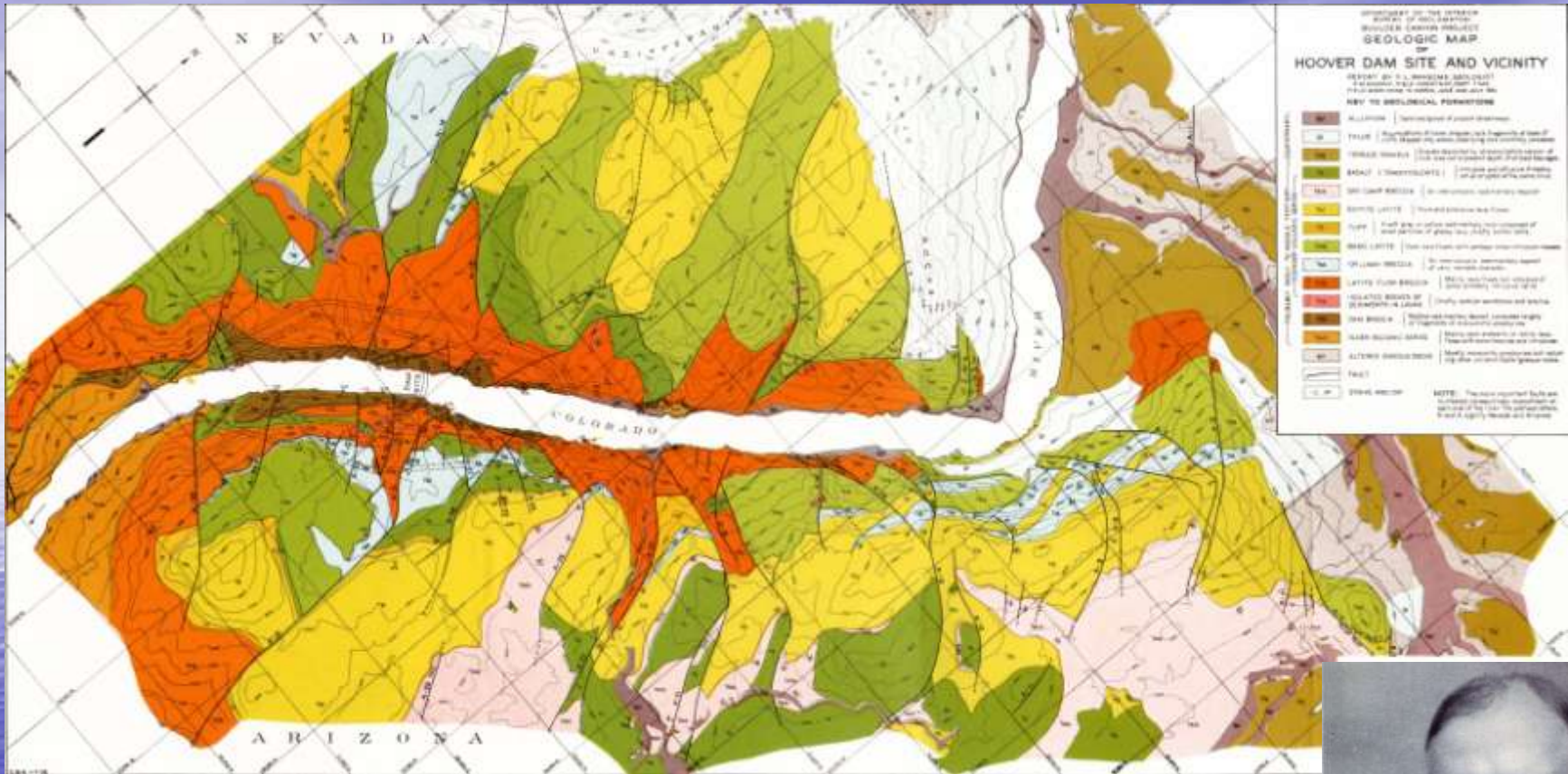


# Potholes in Black Canyon



In 1923 Ransome discovered geologically recent **pothole and rill structures** in a high level channel cut into the andesites above the proposed Hoover Dam site, about 900 feet above the low water surface of the Colorado River.

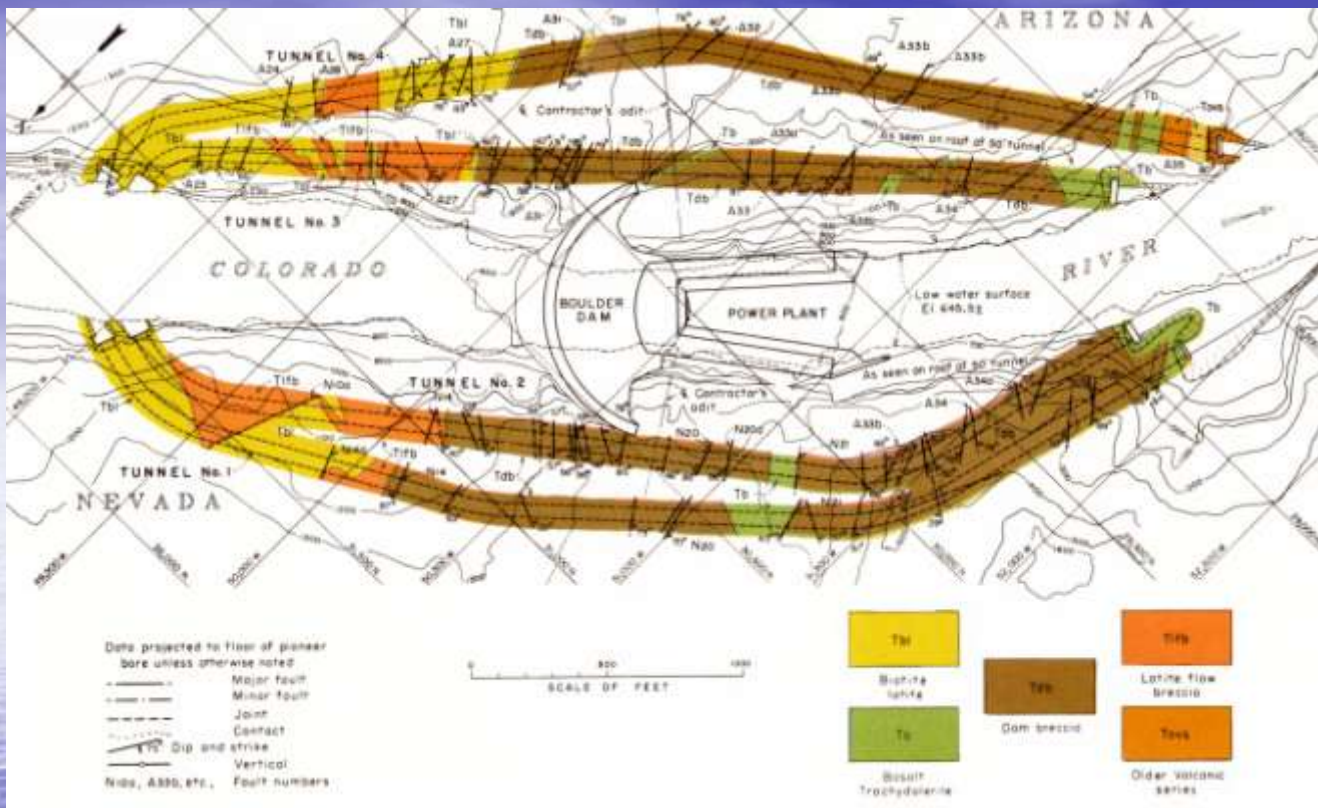
# Ransome mapped Hoover Dam site



Once the Black canyon site was chosen, Ransome returned in 1930 and mapped the site in greater detail, shown here. The dam was founded on the **dam breccia**, a dense reddish unit composed of fragments of monzonitic porphyry; covered by a **latite flow breccia**. The deepest boring extended to a depth of 545 feet below river level.







**Ransome also mapped the diversion tunnels; the largest diameter tunnels ever bored up until that time**



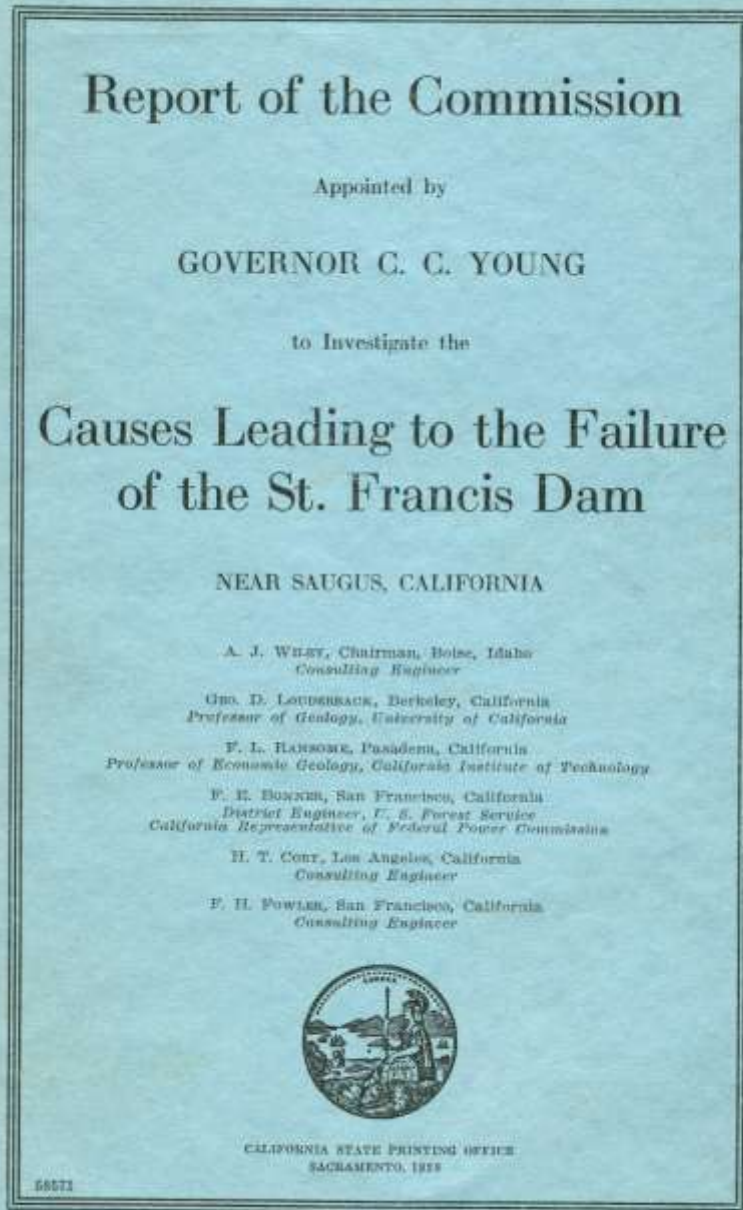


The St. Francis Dam failed in March 1928, killing between 435 and 600 people.

- Ransome was one of two geologists named to the **Governor's Commission to Investigate the Causes of the 1928 St. Francis Dam Failure**. He was the only panelist who was a member of the National Academy of Sciences.

# High Visibility

- Ransome of George Louderback of U.C. Berkeley influenced the panel's findings significantly, pointing to the geologic frailties of the St. Francis Dam site; in particular, the San Francisquito fault.
- Ransome's articles and public testimony about the need for engineering geologic input garnered national attention.



# Spokesman for Engineering Geology



- The American Society of Civil Engineers convened a special Symposium on High Dams at their annual meeting in San Diego in October 1928 **High dams: The Viewpoint of the Geologist**, by F.L. Ransome, Esq.

- Ransome was one of four invited state-of-the-practice papers published in the 1929 ASCE Proceedings
- The four articles and the ensuing discussions occupied 102 pages of the Society's 1931 Transactions, 7% of the entire volume.
- Much of the discussions addressed the problems with St. Francis Dam





**In 1928 the Metropolitan Water District began engaging Ransome to advise them in planning their 241-mile long Colorado River Aqueduct across the Mojave Desert**

**The aqueduct included 92 miles of tunnel and was constructed between 1934-37**



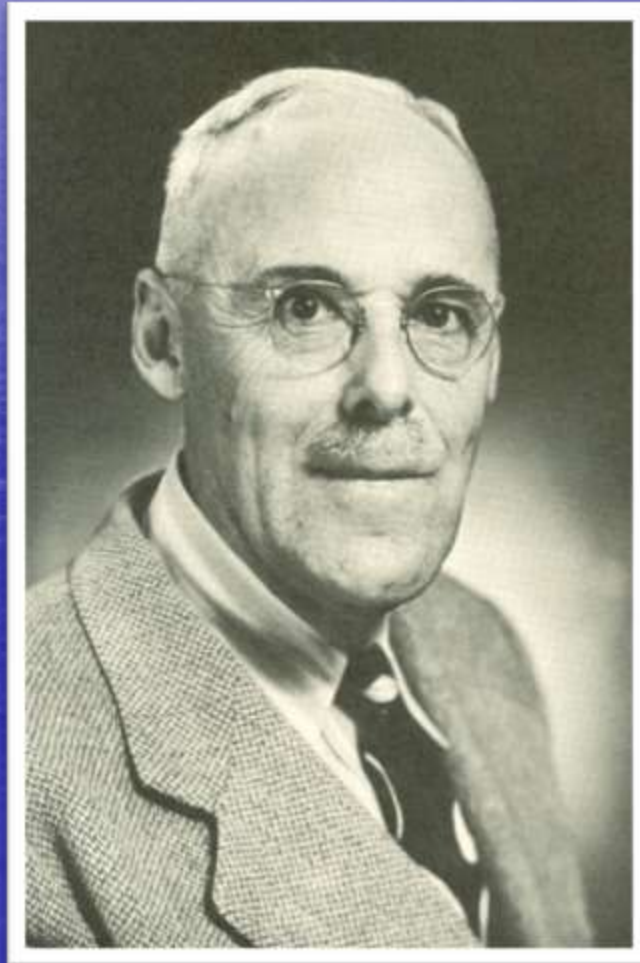
# Ransome died a few days after Hoover Dam Dedication Ceremony



**Leslie Ransome died in Pasadena on October 6, 1935 at age 67, after a protracted illness. It was just 6 days after the dedication of Hoover Dam by President Roosevelt.**



# John P. Buwalda (1886-1954)





## The consummate field geologist who built the largest geology program in the country

- **John P. Buwalda** was born in 1886 in Zeeland, Michigan, to parents who had emigrated from the Netherlands. In 1897 the family moved to Yakima, Washington.
- Upon graduation from high school in 1905, he completed the one year program at Seattle Business College in 1906 and worked as a secretary while attending the University of Washington in Seattle. Here he was introduced to the study of geology by Charles Weaver, but left the university after two years to work in the Coeur d'Alene mines and as a surveyor for the Northern Pacific Railroad.
- In 1909 he enrolled as a geology major at the University of California, and received his bachelor's degree with honors in 1912.

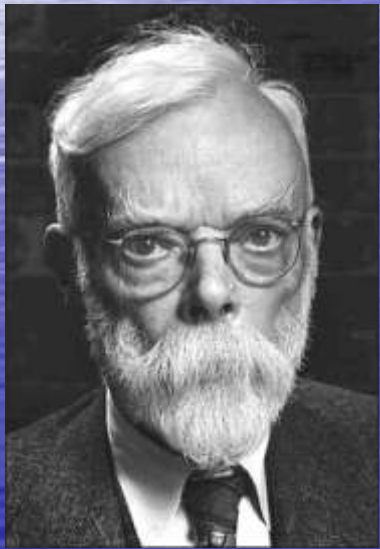






**John C. Merriam**

- Buwalda was awarded the Goeway Research Fellowship and spent the next three years completing his doctorate degree in paleontology under **John C. Merriam**, with a minor in geology, working under **Andrew Lawson**.
- His dissertation dealt with mapping Miocene units in the Tehachapi Range. He was chosen as the Graduate School Orator for Berkeley's 1915 commencement.
- He was promptly offered a faculty position teaching physiography at Berkeley, and during which he developed a life-long interest and competence in geomorphology.
- One of his most intriguing students was a native Berkeleyan named Imra Wann. They were married after she completed her bachelor of laws degree in 1917.



**Andrew C. Lawson**



# Berkeley to Yale, and back to Berkeley 1915-21

- Buwalda accepted a faculty position in geology at Yale in 1917 and remained there four years, spending half of that time working for the USGS in assessing strategic materials during the First World War (1917-18).
- During this same interval Imra became the first female police officer in Washington, DC, working on social intervention as a means of crime prevention, which would become a life-long pursuit.
- John returned to Berkeley in 1921 as a Professor of Geology and Dean of Summer Sessions. It was during this time that he made the **startling discovery of the Hayward fault cutting across the Berkeley campus**, in the excavations being made for Cal Memorial Stadium!



**Merriam**

- By 1925 his long time mentor, **John C. Merriam**, had become President of the Carnegie Institution of Washington, which maintained a seismograph station in Pasadena, in cooperation with the new **California Institute of Technology**, under the direction of its first President **Robert A. Millikan**.
- Millikan applied a full-court press trying to convince Buwalda to come to Pasadena and build a geology program in southern California that would *"be an equal to that in northern California."* Buwalda agonized over the decision for almost a year before agreeing, moving to Pasadena in **January 1926**.
- Within a few months Buwalda hired Chester Stock, one of his former Berkeley colleagues, as Professor of Paleontology, establishing the Department of Geology as one of four major science divisions at Caltech. With Carnegie's Seismological Laboratory a part of their program, **Caltech was the first school to offer courses in geology, paleontology, economic geology, and geophysics in a single program.**



**Millikan**

# Commitment to a curriculum focused on Field Geology



One of John Buwalda's most inspiring traits was his valuation of field training. At Caltech he instituted what was probably the most unique program of study in the United States, requiring undergraduates to take **two summer field camps**; one between their junior and senior year, and another, after their senior year! In addition, during the junior year all students were required to take a **year-long introductory field course**, which convened on weekends.

- They were *also required* to complete a **senior thesis** that was based upon independent field mapping somewhere in southern California. Buwalda continued as the chair of the Geology Division at Caltech for 21 years until his retirement in 1947, at age 60.



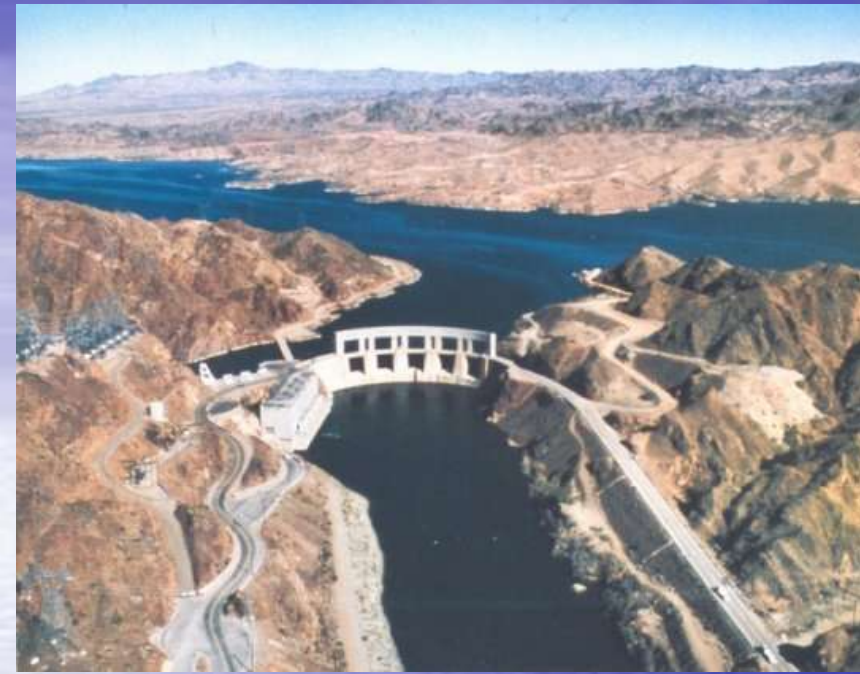
# The Caltech geology faculty in 1936

- Within his first decade as chair, Buwalda succeeded in attracting an inspiring array of talent, including: Leslie Ransome, W.P. Woodring, Ian Campbell, Charles Richter, Hugo Benioff, Beno Gutenberg, and Dick Jahns.





- When Leslie Ransome arrived from Arizona in mid 1927, it wasn't long before he was appointed to a number of important boards and commissions dealing with dam safety, in the wake of the March 1928 **St. Francis Dam failure**. These included consultations on **Hoover Dam** and, afterwards, the **Colorado River Aqueduct** for the newly-formed Metropolitan Water District.
- Ransome brought Buwalda to MWD's attention and it was the latter who assessed the geology of the **Parker Dam** site and surveyed the geology of the aqueduct route eventually chosen by the district, called the "**Parker Line**."
- Buwalda also played an important role in developing earthquake resistant building codes, following the **April 1933 M6.3 Long Beach earthquake**, by providing numerous interviews to newspapers in support of the **Riley and Field Acts** passed that year by the State Legislature.

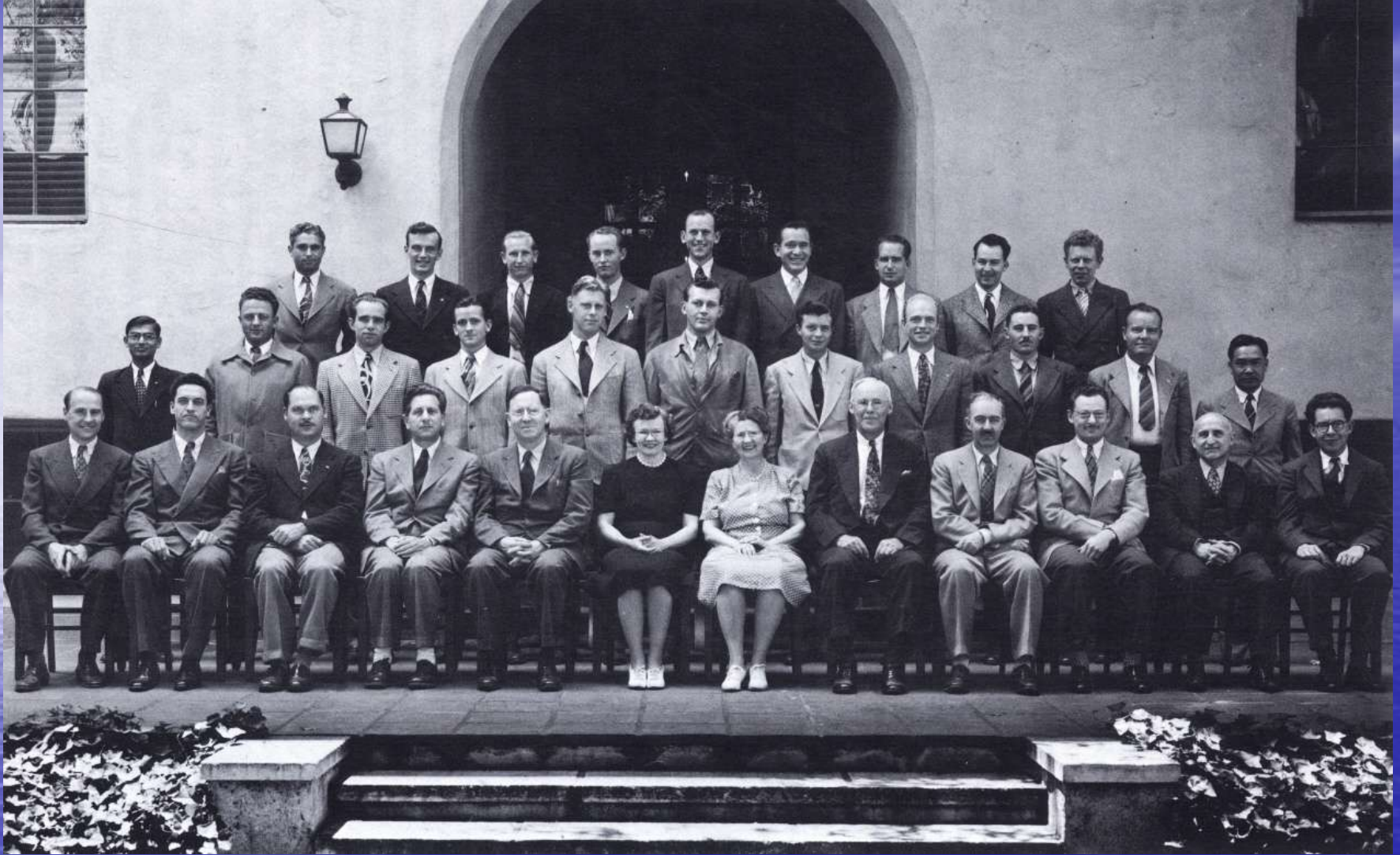


**Parker Dam had the deepest foundation ever attempted for a dam, 245 feet below river level**



**Caljaco Dam in Riverside County was the kingpin MWD distribution reservoir; now known as Lake Matthews.**

- After Leslie Ransome died in 1935, Buwalda succeeded him as the preeminent engineering geologic consultant for MWD. Over the next two decades he produced a series of reports containing remarkable insights on not only the geologic framework, but future performance of engineered structures situated on these sites, which have been remarkably prophetic.**



- By the time Buwalda retired from Caltech in 1947, he had succeeded in assembling the **largest geology department in the United States**, at one of the smallest schools.







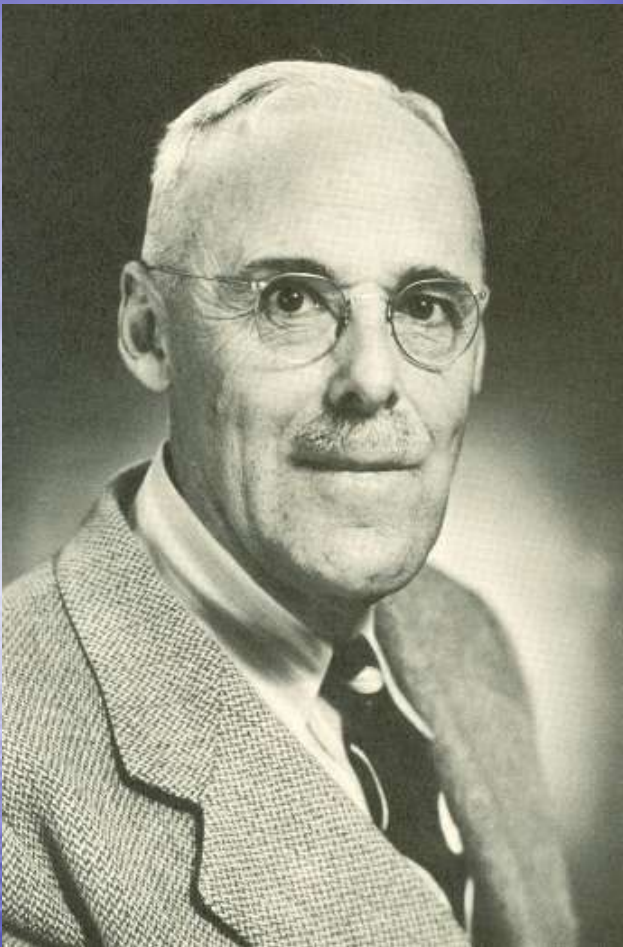
Buwalda continued to consult for MWD on an array of challenging projects, including the **Garvey Reservoir** site. His 1952 report contained some remarkable insights and predictions about potential problems with differential settlement and hydraulic piping that could be triggered by earthquakes!





- The occurrence of the **M 7.5 Arvin-Tehachapi earthquake in July 1952** seemed to invigorate John Buwalda, as it occurred in the area he had mapped as part of his Ph.D. dissertation almost four decades previous.
- He spent the balance of the summer of 1952 in the field mapping and examining the surface rupture features and trying to unravel the underlying structures. Colleagues remarked that he appeared 10 years younger the following fall.

# John Peter Buwalda 1886-1954



- On August 19, 1954 Buwalda spent the day with his 21-year old son Robert in the field near Frazier Park, developing input for an engineering geologic tour of the Transverse Ranges he was slated to lead for the upcoming annual meeting of the Geological Society of America in November. While returning to their car at the end of that memorable outing, he collapsed and died of a heart attack.

# Rollin Eckis (1905-1999)





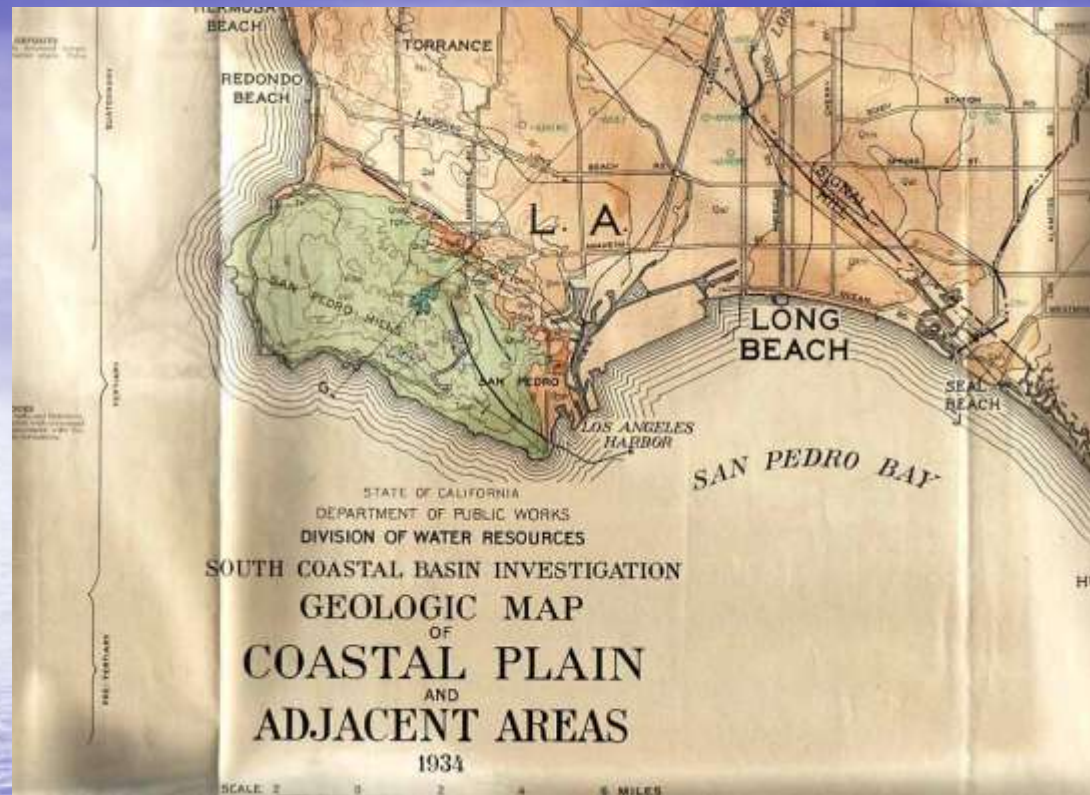
- **Rollin Eckis** was born in Oakland, California on June 26, 1905, 10 months before the San Francisco earthquake. After high school, he attended San Diego Normal School for two years before transferring to a 4-yr school.
- While enrolling at Pomona College, an energetic geology professor named **A.O. Woodford** convinced young Rollin to major in geology, and he graduated in 1927.
- He maintained this mentorship with **Professor A.O. Woodford** (shown here) until Woodford's death in 1990, at age 100.



- His senior thesis topic was “*The Alluvial Fans of the Cucamonga District,*” which became a classic work on alluvial fan development when published in the *Journal of Geology* in 1928.



# Rollin Eckis groundwater pioneer and petroleum geologist



- Eckis pursued graduate studies at the **California Institute of Technology**, defending his masters degree in **1930**. He remained there working on his doctorate, examining the groundwater basins of Los Angeles. In 1932 he was the first geologist hired by the State Division of Water Resources, where he planned to complete his dissertation while working at their Los Angeles office.
- Between 1932-34 Eckis completed a pioneering study of the storage capacity of the **South Coastal Basin** of Los Angeles, summarized in DWR **Bulletin 45**. **This became one of the seminal documents on understanding groundwater resources in southern California.**
- In 1934 budget cutbacks caused by the Great Economic Depression of the 1930s eliminated his position and he was forced to give up his dream of completing his doctorate.

# Major Oil Field Discoveries

- In 1934 Rollin Eckis accepted an entry-level position as field geologist with the Texas Company, working in the San Joaquin Valley. After 3-1/2 years he joined the exploration department of the **Richfield Oil Company** as their district geologist for the San Joaquin Valley. At that time Richfield's geologists included Harold Hoots, Manley Natland, Mason Hill, and Tom Dibblee!
- Using new geophysical techniques, Eckis discovered the **North Coles Levee Oilfield** near Bakersfield in 1938, which produced 132 million barrels of oil and 72 billion cubic feet of gas.
- From that point onward, he succeeded in making major oilfield discoveries about every 10 years, including: the **Wheeler Ridge Eocene pools in 1946**, **Cuyama Valley in 1948**, the **Cook Inlet area of Alaska in 1958**, and the **Prudoe Bay, Alaskan North Slope oil field in 1968**.
- Rollin Eckis was appointed Chief Geologist of Richfield in 1948, Manager of Exploration in 1954, and President in 1962. He became **Executive Vice President of Arco** when Richfield merged with Atlantic Refining Company in 1966, where he served at their Los Angeles headquarters until his retirement in 1977.





Pomona College Professor A.O. Woodford (left) with the college president and Mason Hill, upon the conferring of his honorary doctorate in 1968.

- **Fellow Pomona alumnus Mason Hill actually went to work for Richfield before Eckis, in late 1936. The other geologist were all Stanford0trained.**
- **When Eckis took over management of Richfield's Exploration Department in 1954 he named Mason Hill at the company's Chief Geologist.**
- **Mason Hill joined the board of Pomona College in 1957 and they awarded him an honorary doctorate of science (D.Sc.) in 1968 (shown at upper right).**

# Annual Woodford-Eckis lecture and the Eckis Chair in Seismology



**Rollin Eckis and A.O. Woodford**

