Albert Michelson and His Famous Optics Experiment at Irvine Ranch in 1930

Albert Michelson was the first American to be awarded a Nobel Prize in Science.

Albert Michelson is an excellent example of the self-motivated successful American. In 1854 he immigrated to America with his parents when he was two years old. He came from Prussia, his family leaving because of war and political upheaval there. His hometown in America was a gold mining camp in California, Murphy's Diggings in Calaveras County. (The town is now known as Murphys and is a popular tourist attraction as California's best preserved mining town.)

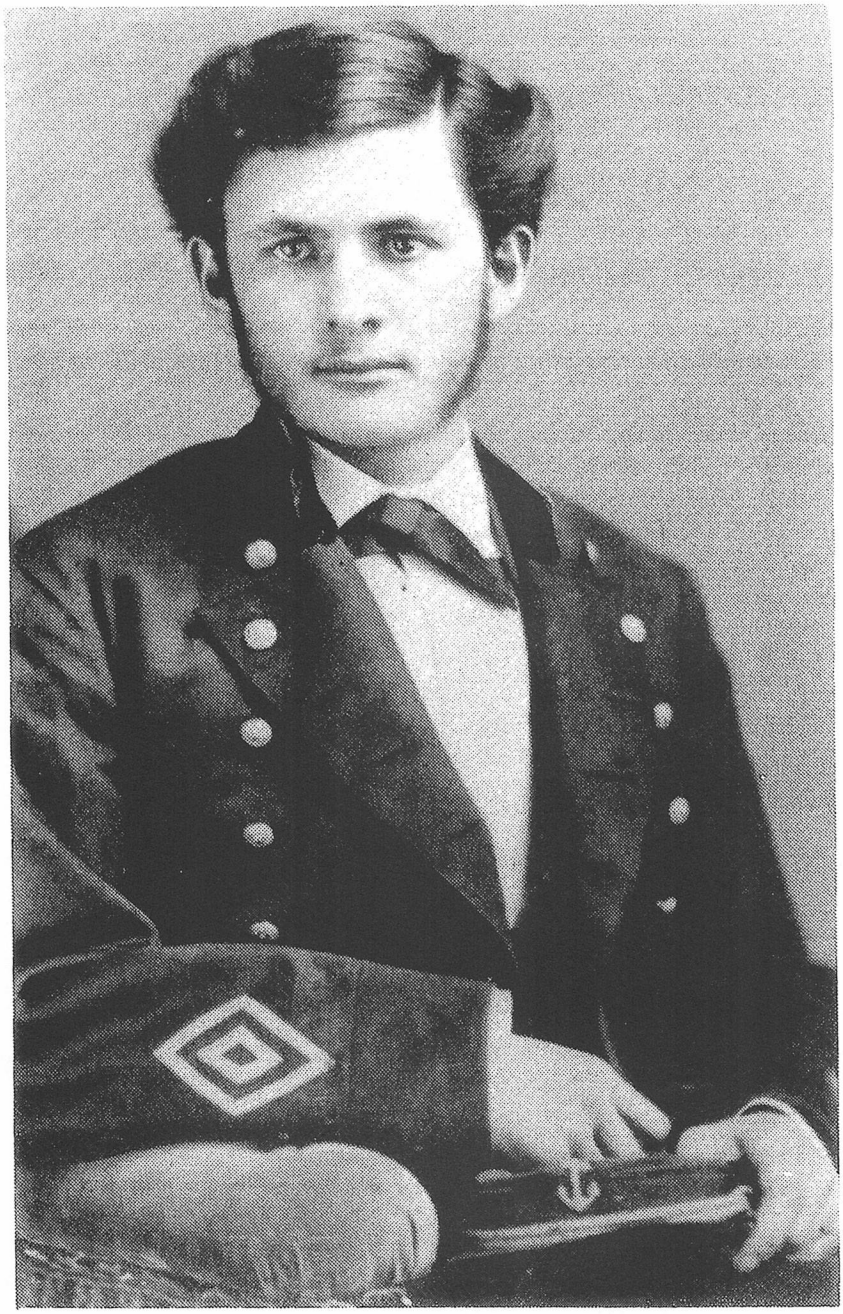
Michelson grew up among the science and industry of mining and showed early ability in mathematics. His parents sent him to San Francisco to attend Boys' High School in 1869, and entered the United States Naval Academy in Annapolis, Maryland, in the Class of 1873. He became instructor at the Academy and set up his first experiment to measure the speed of light on the seawall at Annapolis. By 1878 he had increased the precision of the measurement of the speed of light by 200 times, only one-tenth of one percent higher than the currently accepted value.

After a three-year tour of study in French and German universities, he returned to America to be a faculty member at Case Western Reserve University in Cleveland, Ohio. In 1892 he became head of the physics department of the University of Chicago, and was later president of the National Academy of Science.

Michelson traveled a long road from an immigrant boy in a mining camp, with English as a second language, to a world-famous scientist.

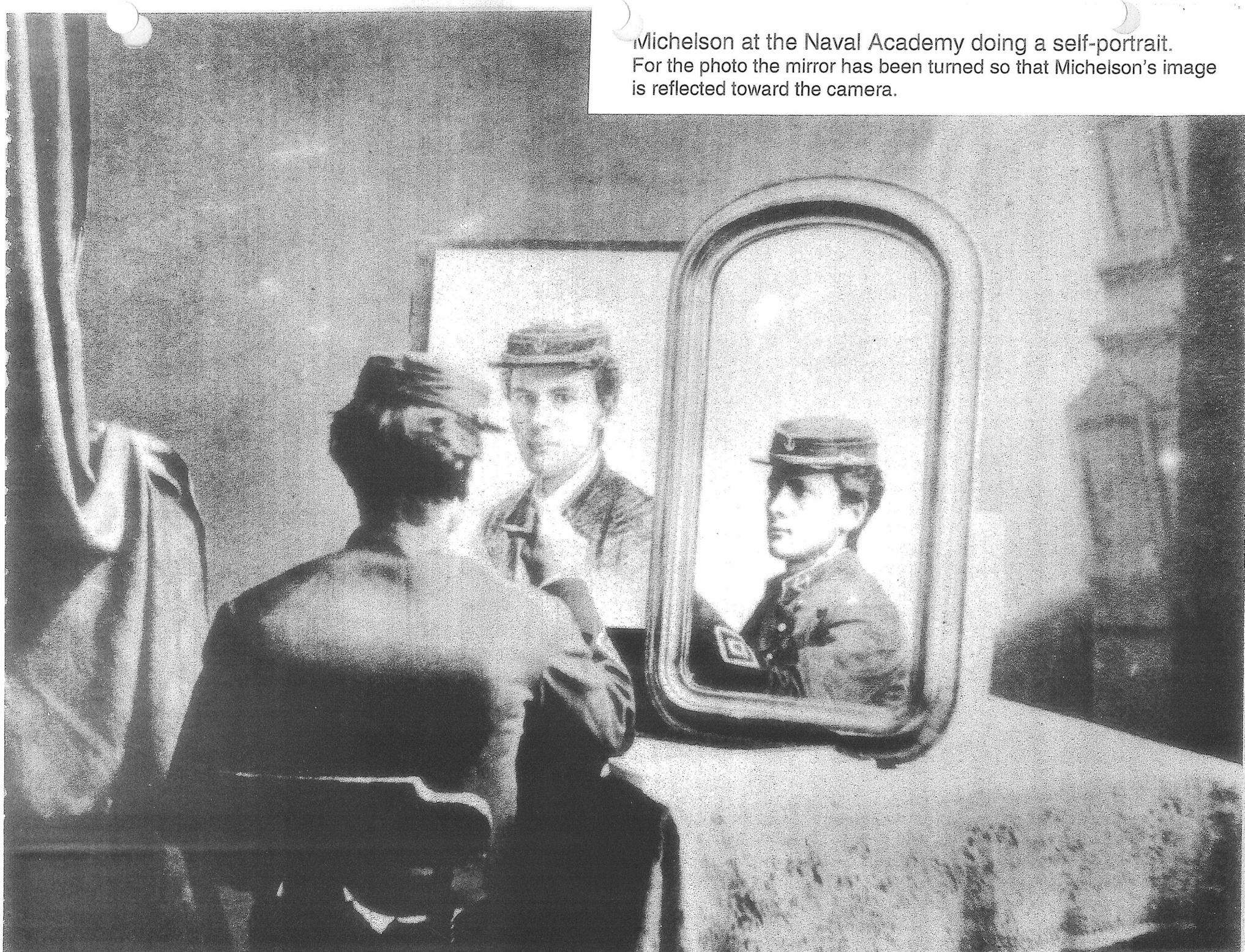
His last experiment was at Irvine Ranch in Orange County in 1930.

Albert Michelson won 1907 Nobel Prize in Physics
for the development of optical precision instruments. He accurately measured the speed of light and confirmed that light is a wave motion. By the principle of interferometry, which he established as an important experimental tool, he determined fundamental properties of matter and radiation. His experimental results lead directly to the theory of relativity and the development of lasers.



Cadet Midshipman Albert A. Michelson in 1873. Portrait in the *Logbook* of the graduating class of that year at the U.S. Naval Academy, Annapolis, Maryland.

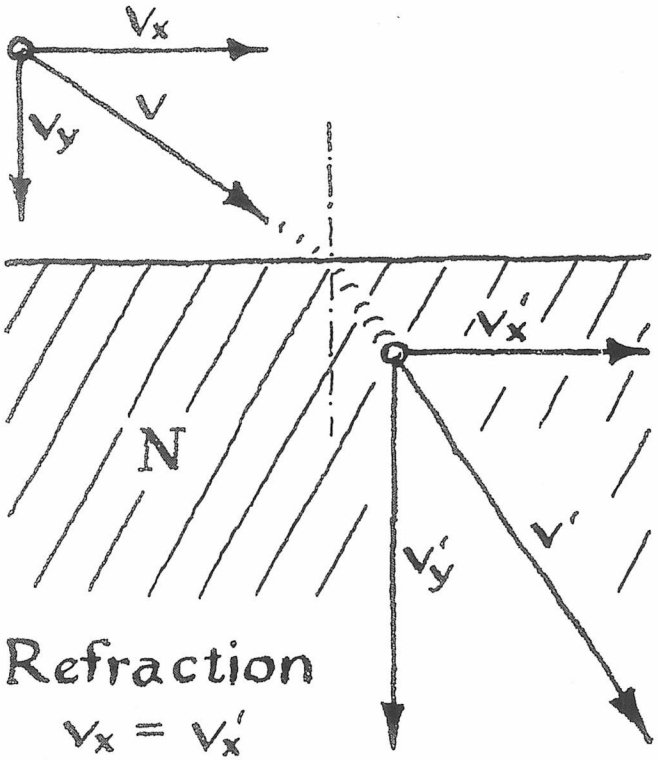
President Grant appointed Michelson to the Naval Academy on an exception after Michelson visited him in the White House. He graduated in 1873, ranking ninth in his class of 29. He was first in optics, acoustics and drawing (cartography), and second in mathematics

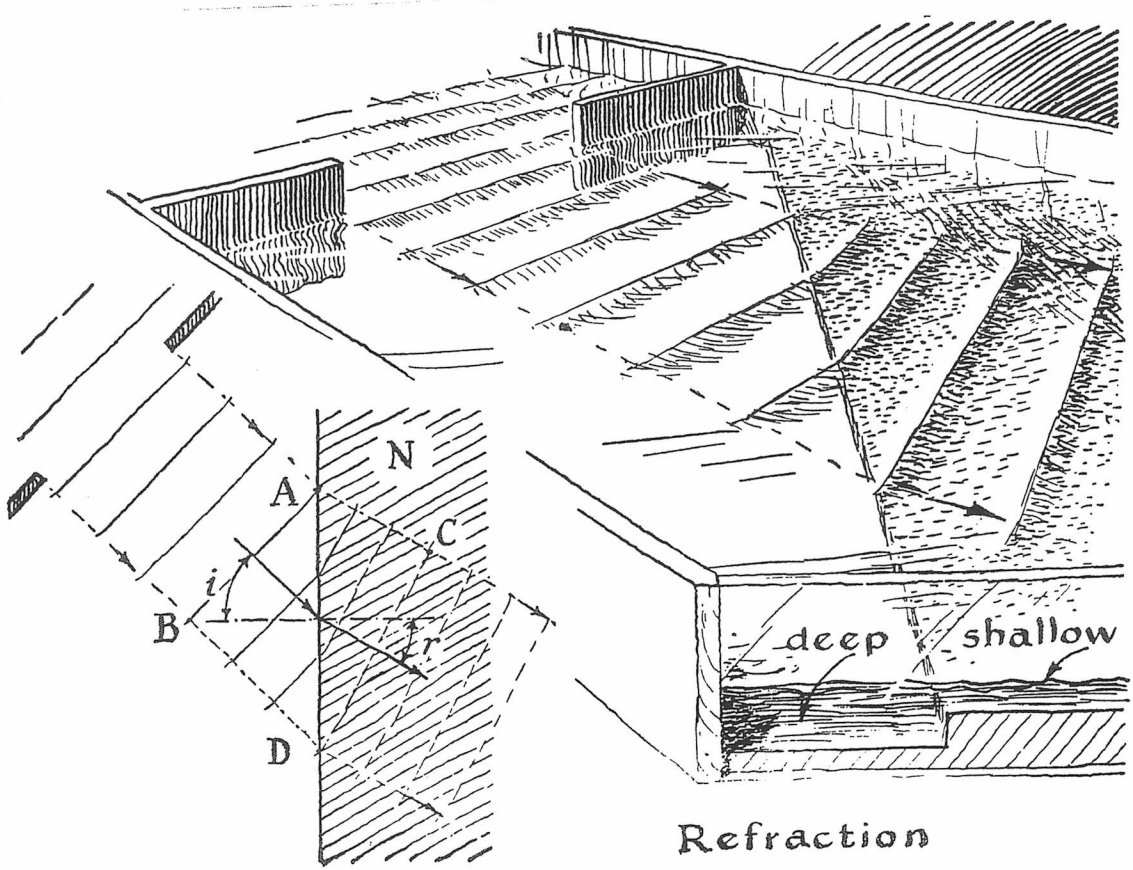


Michelson at the Naval Academy doing a self-portrait. For the photo the mirror has been turned so that Michelson's image is reflected toward the camera.

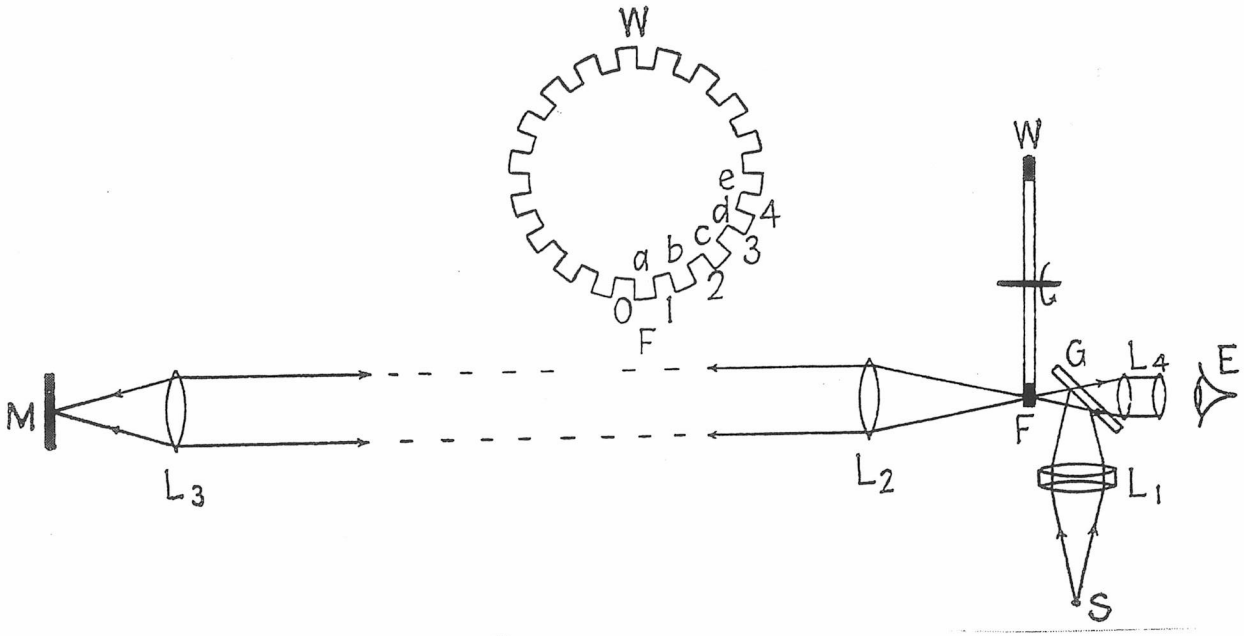
Is light particles or waves?

If particle, velocity in glass is greater than in air
If wave, velocity in glass is less than in air



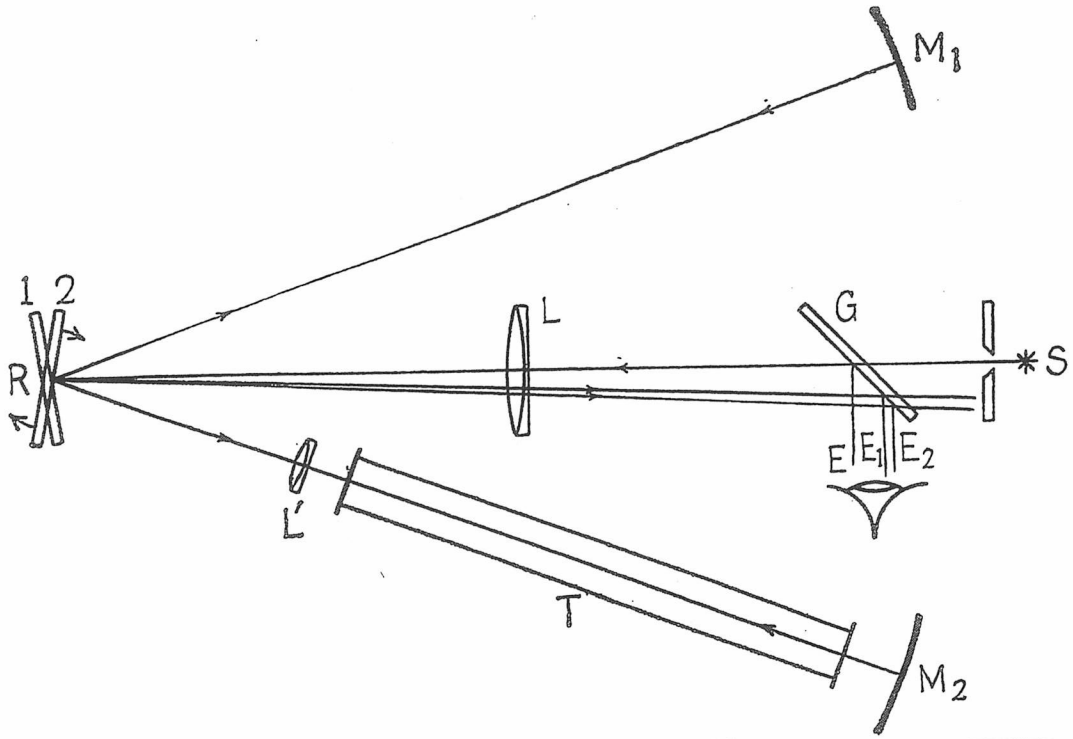


Speed of light in air (1878)



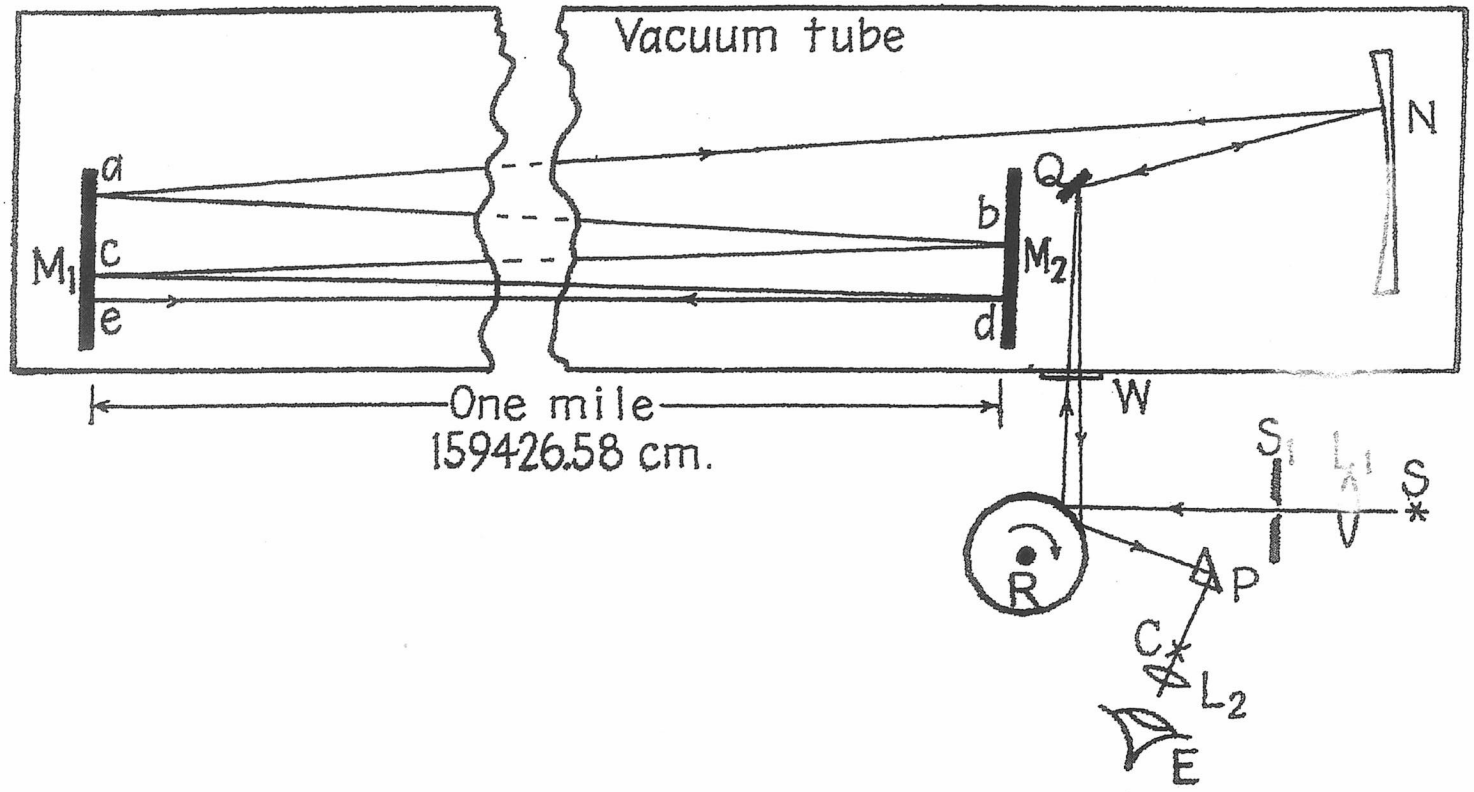
Speed of light in water

Crucial experiment to decide between particle and wave theories of light
(Foucault in 1850, Michelson in 1885)
Concept of "group velocity"
—index of refraction depends on wavelength



Irvine Ranch Experiment (1931)

Speed of light in partial vacuum



Santa Ana Register

FINAL EDITION

HOOVER WELCOMES ADMIRAL BYRD

Dr. Michelson In Santa Ana To Test Speed Of Light

WORK TO BE CONDUCTED AFTER DARK

WESTOVER, JACKSON GIVEN SUPPORT OF DRYS

SCIENTIST ARRIVES

SCIENTISTS ARRIVE

Clara Bow Is Still In Love With Richman

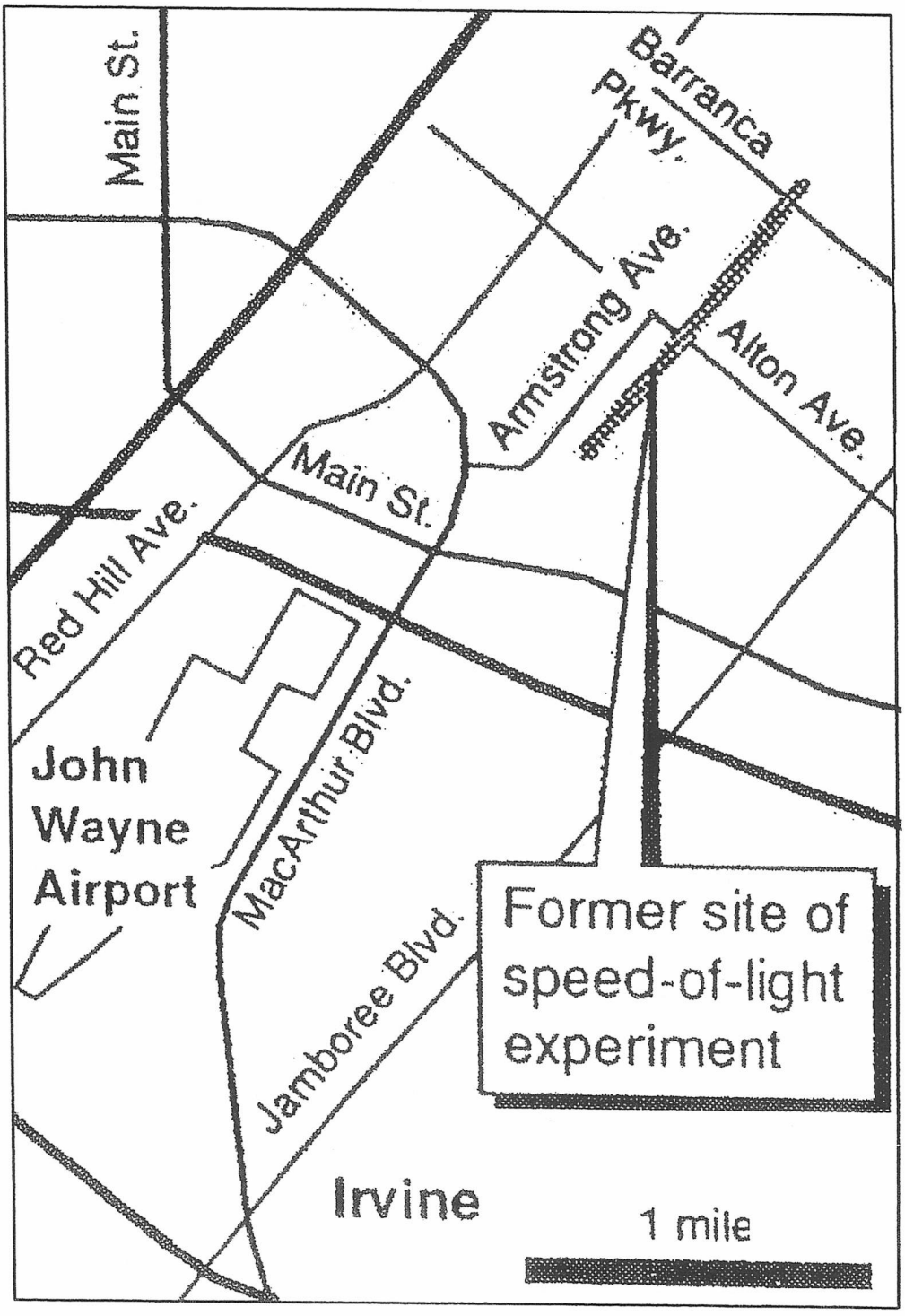
FUNERAL FOR C. E. PARKER TO BE SATURDAY

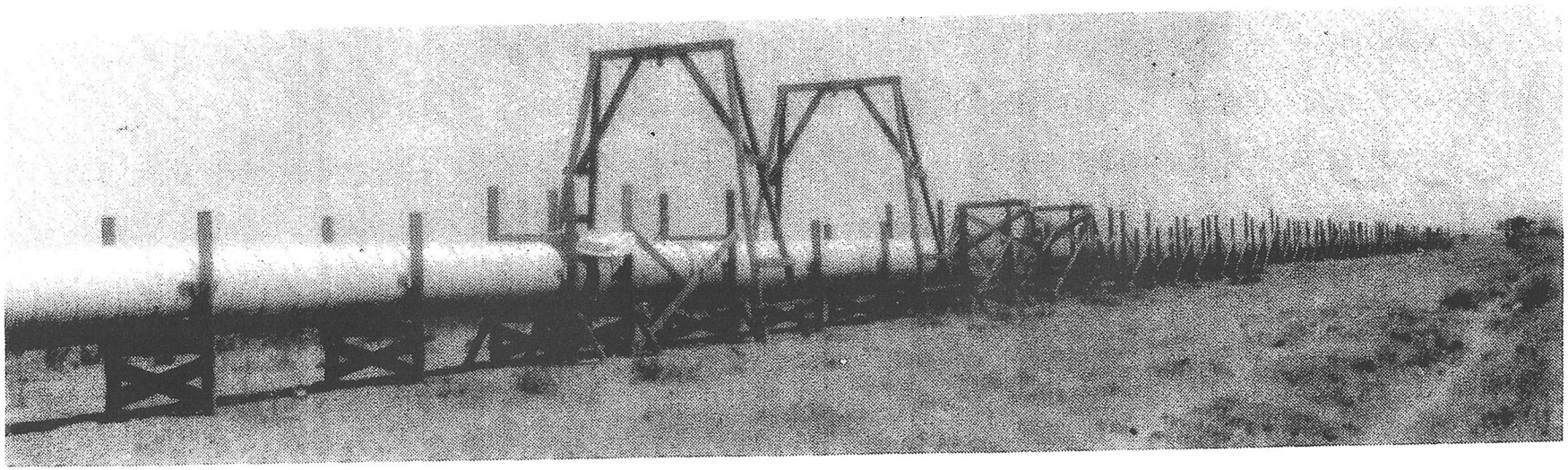
Endorsed By Prohibition Leaders Here

STOCK MARKET VALUES SLUMP IN NEW YORK

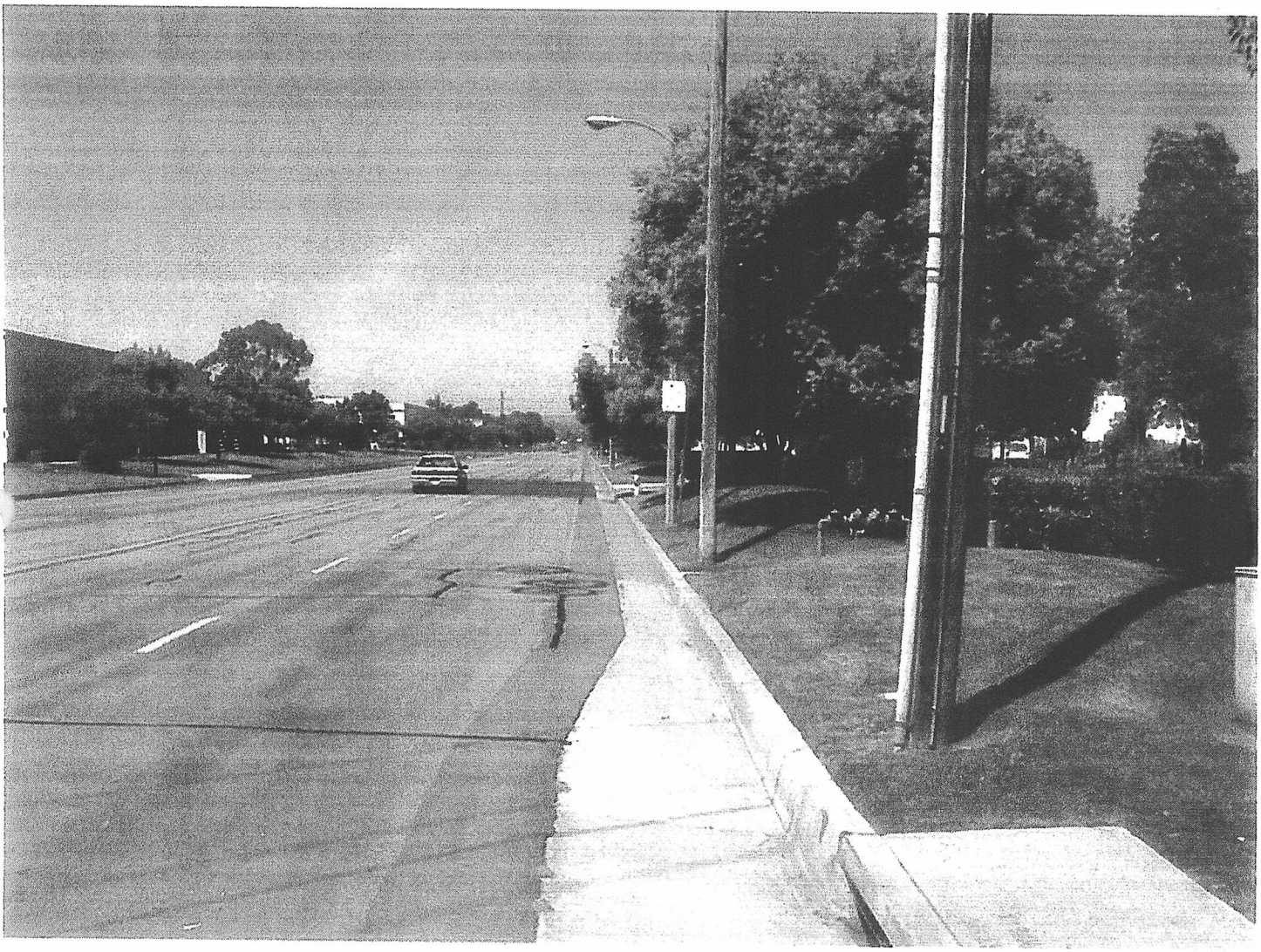
EXPLORERS CHEERED BY THOUSANDS

'The Master of Light'

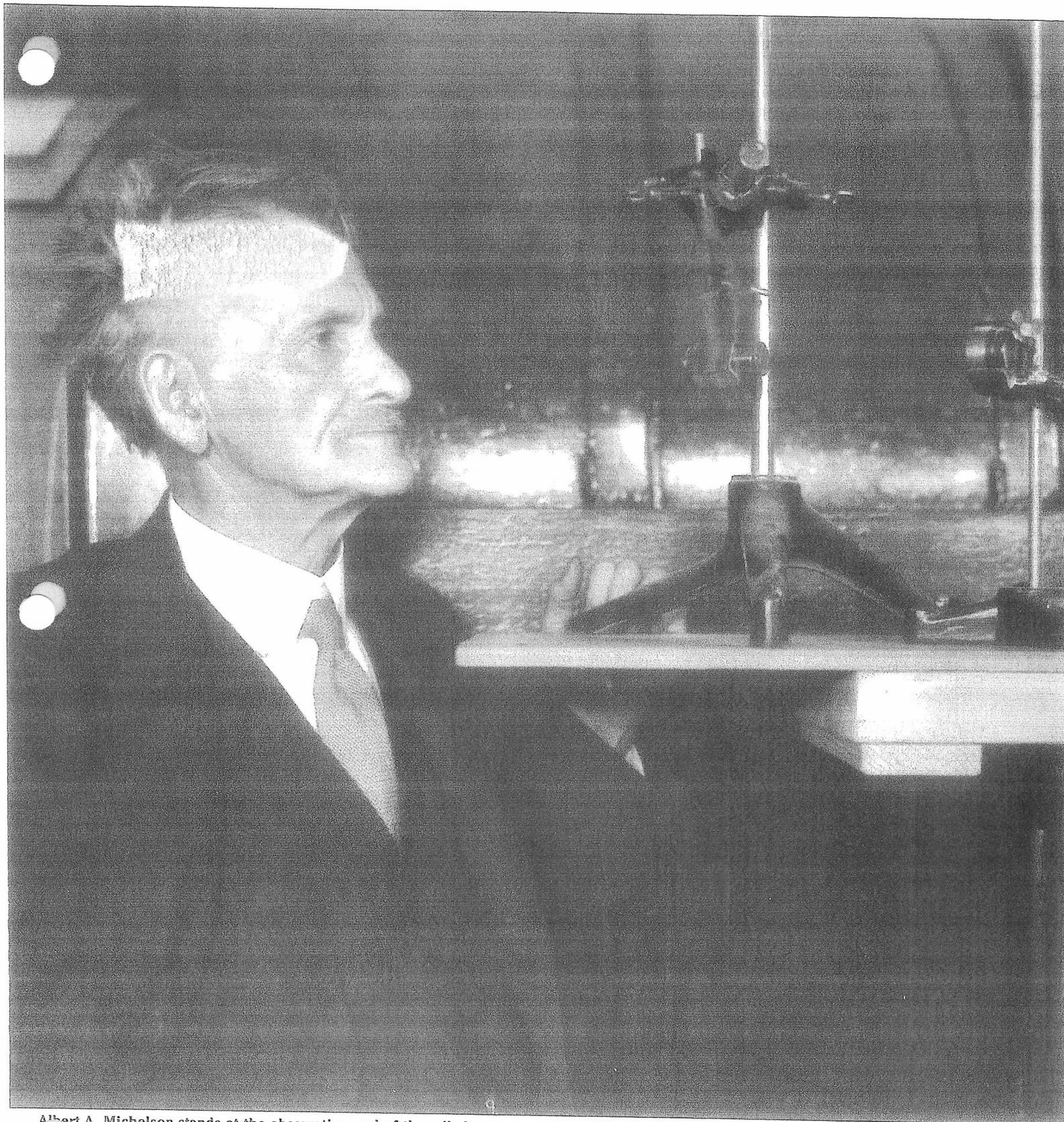

Main St.
Barranca Pkwy.
Armstrong Ave.
Alton Ave.
Main St.
Red Hill Ave.
John Wayne Airport
MacArthur Blvd.
Jamboree Blvd.
Former site of speed-of-light experiment
Irvine
1 mile



The center section of the 16-m-long evacuated pipe set up in 1930 on the Irvine Ranch near Santa Ana, California, for Michelson to measure the velocity of light in a partial vacuum.



Armstrong Ave. looking east towards Tustin Marine Corps Air Station
Experiment was on the rightside but no structures remain



Albert A. Michelson stands at the observation end of the mile-long vacuum tube through which he made his last measurements of the speed of light. The photograph was taken in Santa Ana, California, in February 1931, three months before his death.

Scientific Publication on Irvine Ranch Experiment:

A.A. Michelson, F.G. Pease and F. Pearson, Astrophys. Journal, Vol. 82, pp. 26-61 (1935)

MEASUREMENT OF THE VELOCITY OF LIGHT IN A PARTIAL VACUUM*

By A. A. MICHELSON,[1] F. G. PEASE, AND F. PEARSON

ABSTRACT

The observations were made by the rotating-mirror method, the light passing through a steel tube 1 mile long, evacuated to pressures which ranged from 0.5 to 5.5 mm mercury. By multiple reflections the path length was increased to 8 or 10 miles.

The distance was obtained by reference to a carefully measured base line adjoining the tube.

The time was measured stroboscopically through successive steps by use of a tuning fork synchronized with the rotating mirror, a free swinging pendulum, a chronometer, and wireless signals from Arlington.

There were made 2885.5 determinations of the velocity, the simple mean value of which is 299,774 km/sec., with an average deviation of 11 km/sec. from the mean.

INTRODUCTION

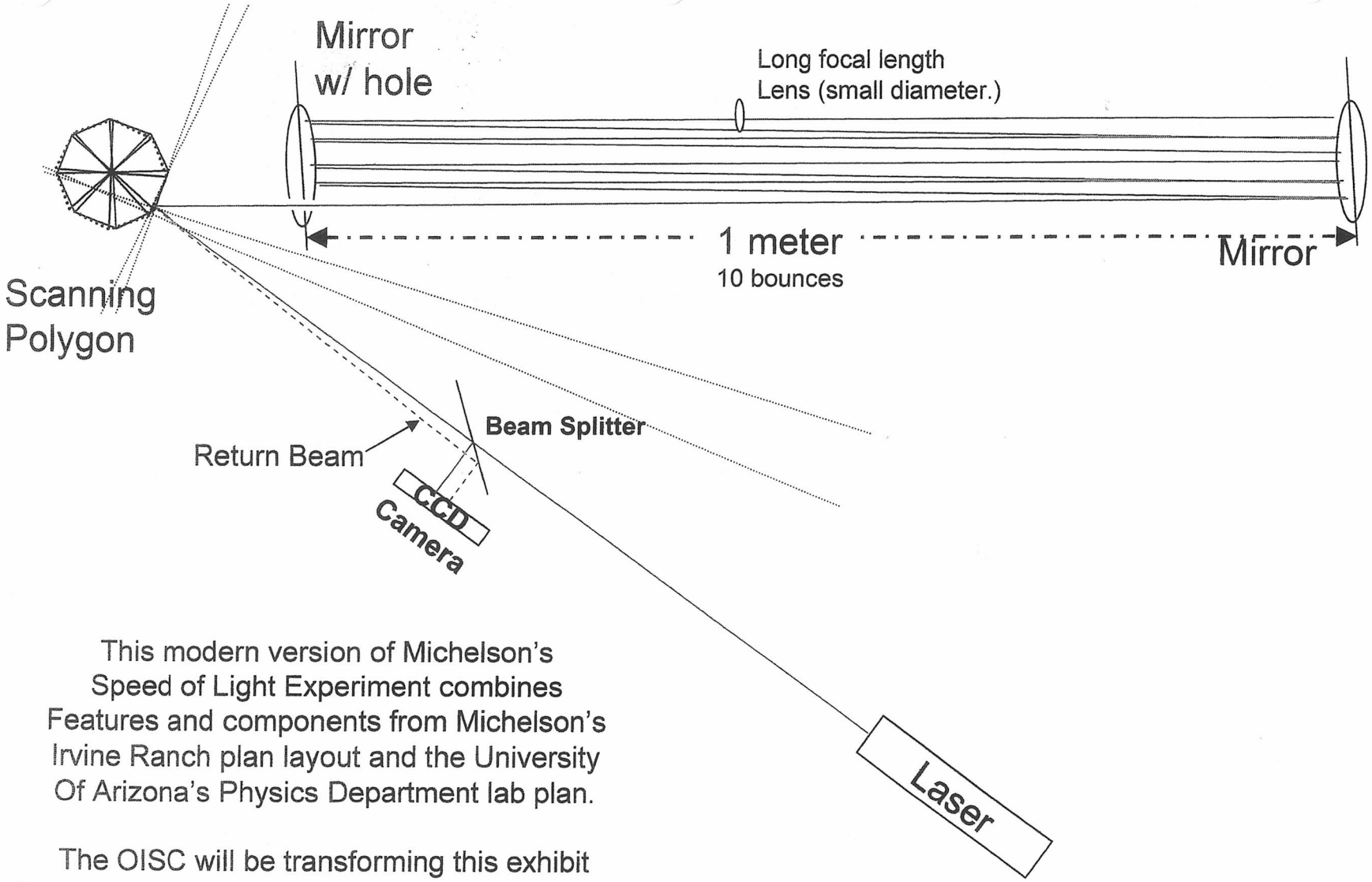
The following is a report on the measurements of the velocity of light made at the Irvine Ranch near Santa Ana, California, during the period September, 1929, to March, 1933. The undertaking was proposed and planned by A. A. Michelson, professor of physics at the University of Chicago and research associate of the Carnegie Institution. Professor Michelson also obtained the funds for the project and lived to see the apparatus installed but was unable to take part in the measurements, which were carried out by F. G. Pease, of the Mount Wilson Observatory, and F. Pearson, of the University of Chicago.

It will be recalled that a series of measurements of the velocity of light had been made between Mount Wilson and Mount San Antonio in 1924–1926 which gave a value of 299,796 km/sec.[2] Since the internal agreement of these measures was good, some explanation is desirable as to why it was thought necessary to repeat the experiment at the Irvine Ranch. The measurements involve two distinct

* *Contributions from the Mount Wilson Observatory, Carnegie Institution of Washington*, No. 522.

[1] Dr. Michelson died on May 9, 1931, when 36 of the 54 series of 1931 observations had been completed.

[2] *Mt. W. Contr.*, No. 329; *Ap. J.*, 65, 1, 1927.



This modern version of Michelson's
Speed of Light Experiment combines
Features and components from Michelson's
Irvine Ranch plan layout and the University
Of Arizona's Physics Department lab plan.

The OISC will be transforming this exhibit
Into a live working demonstration for a computer
Controlled Hands-On Optics experience.

Check our web site for more details
http://oisc.net