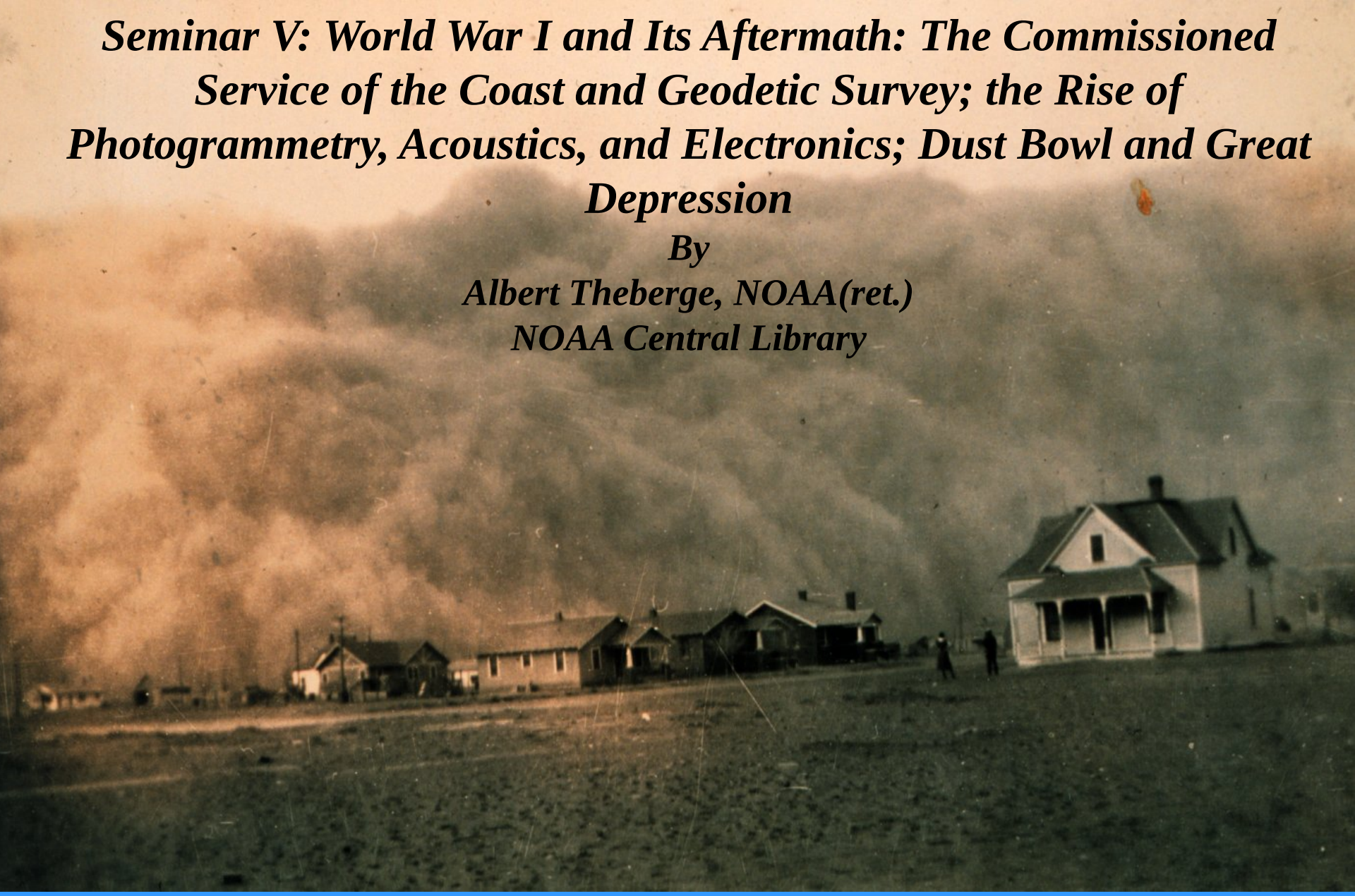
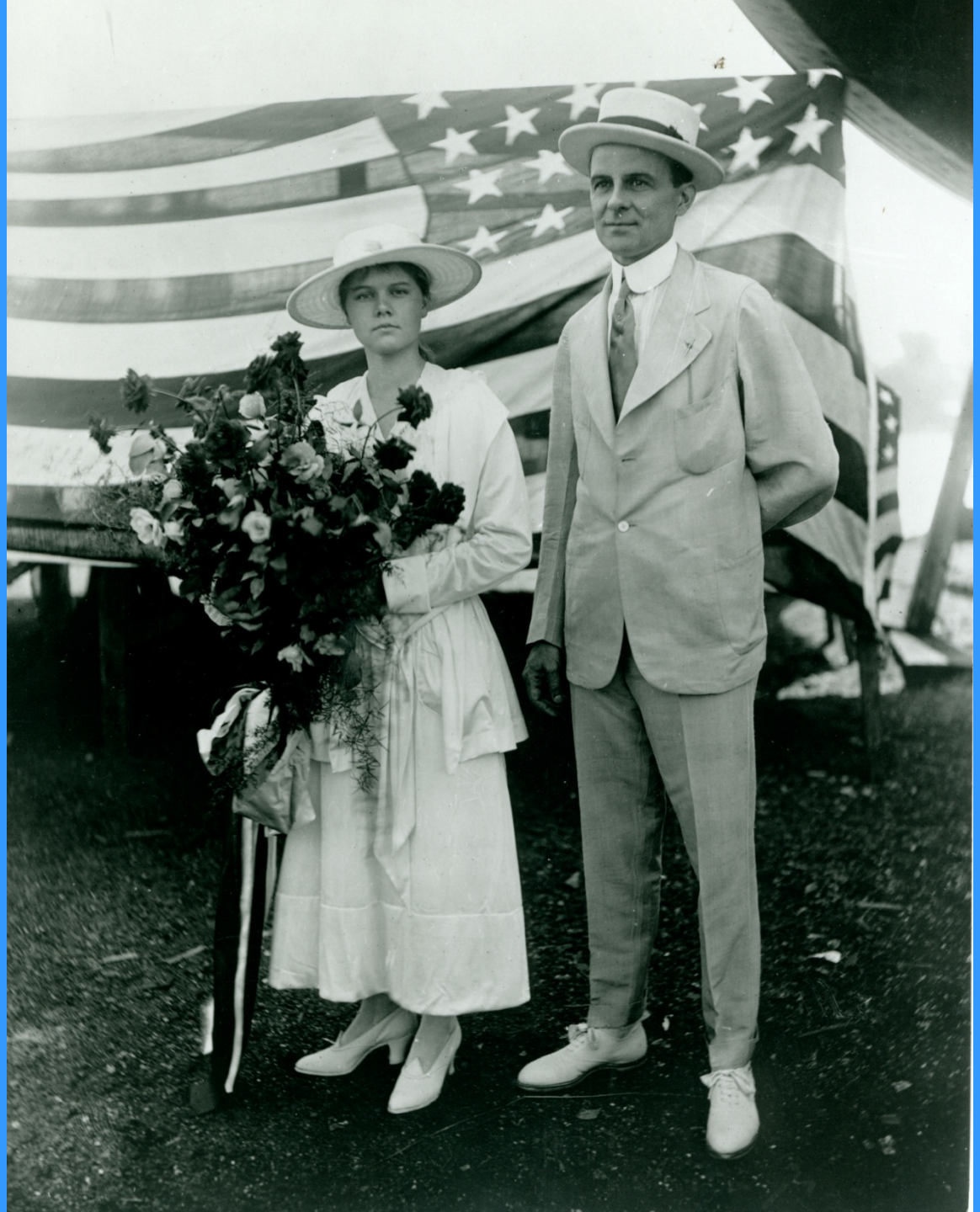
# *Seminar V: World War I and Its Aftermath: The Commissioned Service of the Coast and Geodetic Survey; the Rise of Photogrammetry, Acoustics, and Electronics; Dust Bowl and Great Depression*

***By***

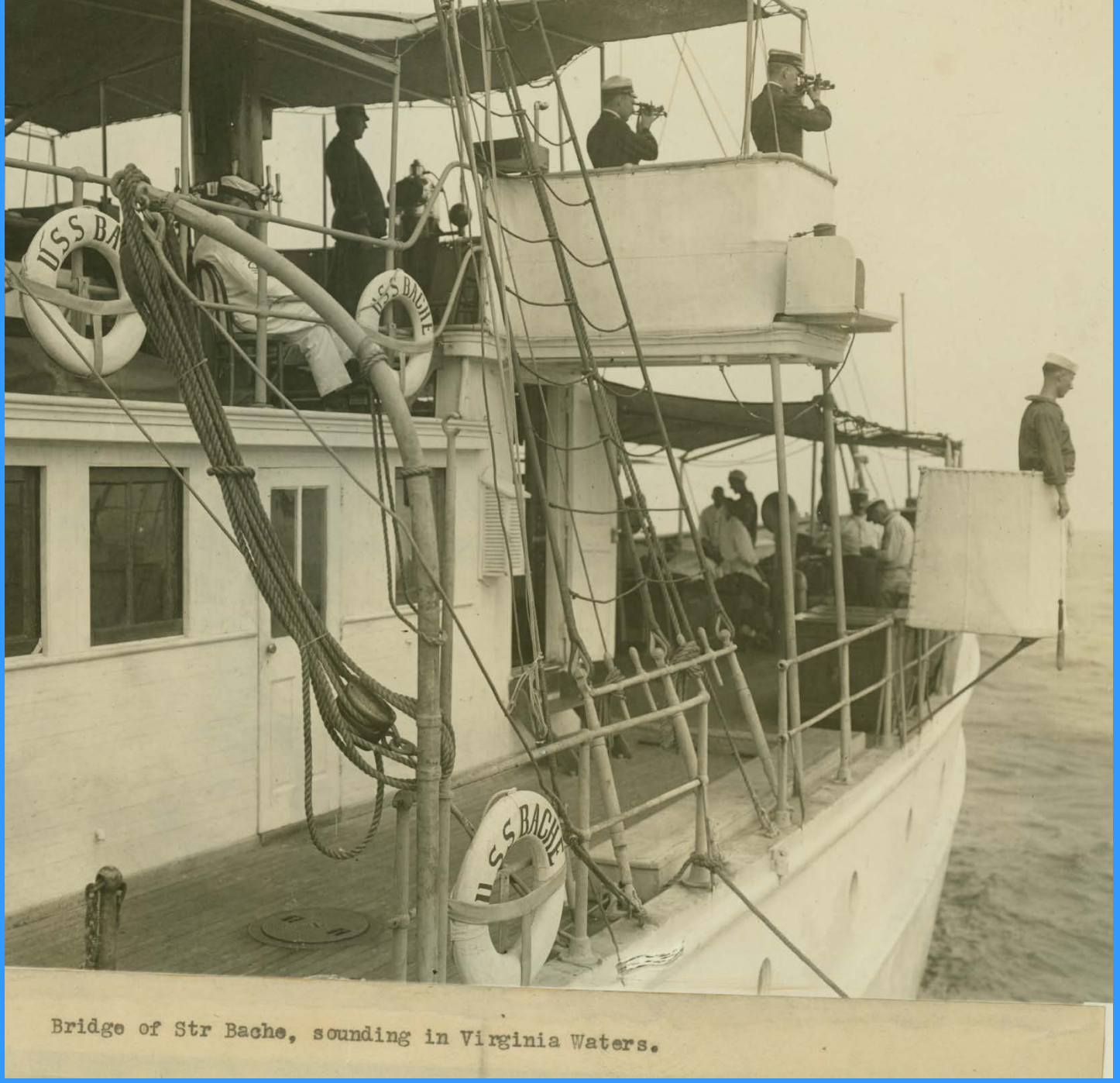
***Albert Theberge, NOAA(ret.)***

***NOAA Central Library***



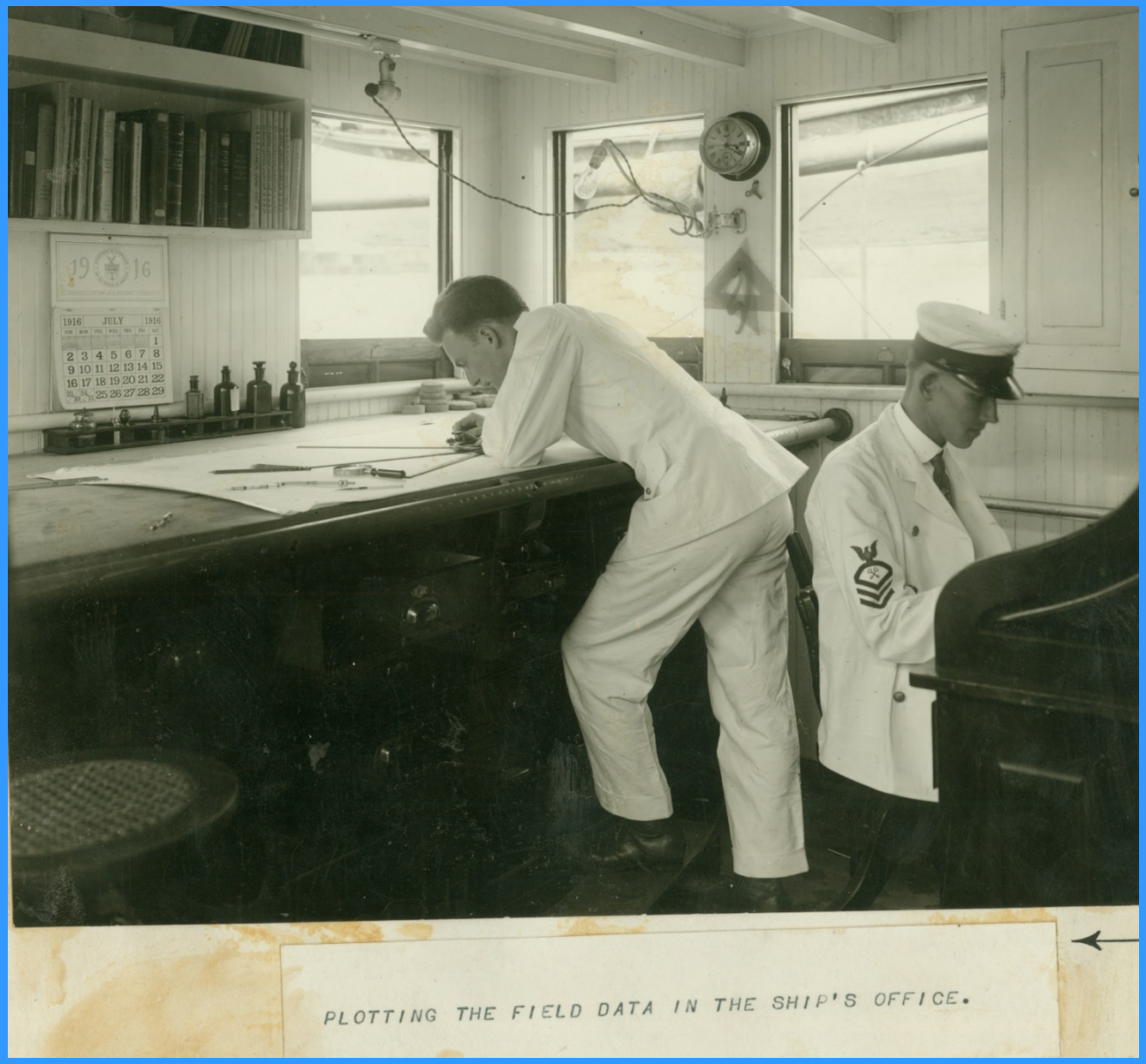


**Ernest Lester Jones, Director of the Coast and Geodetic Survey 1915-1929, and daughter at patriotic event. This picture was undated but Jones can be imagined to have dressed in this manner prior to the U.S. entry into WW I.**



Bridge of Str Bache, sounding in Virginia Waters.

**Hydrographic data acquisition at the beginning of E. Lester Jones's tenure as Director of the Coast and Geodetic Survey. The ship's were old and Jones embarked on a ship procurement program.**




**Data processing. This method of producing the shipboard smooth sheet extended well into the 1970's.**

# Coast and Geodetic Survey and World War I

**First World War – Law enacted making field force of Coast Survey commissioned officers and able to be transferred into armed services – ½ transferred to Army, Navy, Marines serving as hydrographers, navigators, artillery surveyors, mine sweeping officers, researchers, etc.**

# WAR RECORD
## UNITED STATES COAST AND GEODETIC SURVEY SHIP
# SURVEYOR
## WHILE ON TEMPORARY DUTY IN THE
## UNITED STATES NAVY

Fitting out for overseas duty in Norfolk Navy Yard Sept. 24, 1917 to Jan. 7, 1918.
Left Norfolk, Va. for European Waters Jan. 8, 1918.
Arrived in War Zone Feb. 1, 1918.

On convoy and escort duty in North Atlantic from Feb. 1, to March 8, 1918, touching at San Miguel, Azores; Bere Haven, Ireland; and Pembroke, Wales.

On convoy and escort duty, Mediterranean and Atlantic from March 8, to Nov. 11, 1918, basing on Gibraltar and visiting Oran, Algeria; Villefranche, France; Genoa, Italy; Bizerta, Tunis; Lisbon, Portugal; Casablanca, Morocco; and Tangier.

From Nov. 11, to Dec. 31, 1918, visited Algiers, Algeria, and touched at San Miguel, Azores; and Ireland Island, Bermuda en route to Norfolk, Va.

From Jan. 1 to March 31, 1919 in Norfolk Navy Yard being prepared for transfer back to the Coast and Geodetic Survey.

### PARTICIPATED IN THE FOLLOWING SUBMARINE ATTACKS AND ENGAGEMENTS

May 11, 1918 in the Mediterranean, off Bizerta, submarine attack and sinking of Fr. S.S. "Susette Fraisinette by German submarine U-B 52.

May 17, 1918 in the Mediterranean, off Oran, submarine attack and sinking of Br. S. S. "Mavisbrook and torpedoing of Br. S. S. "Elswick Grange" and "Sculptor" followed by depth charge bombardment and damaging of German submarine U 39, which interned at Cartagena, Spain the following day.

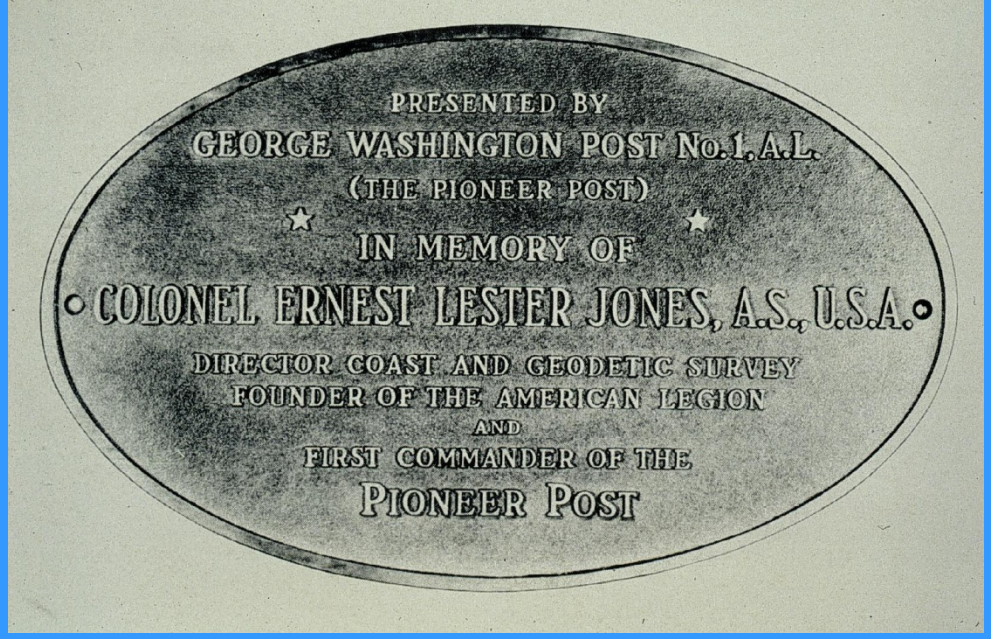
### ARMAMENT

2-3 inch 50 caliber guns
2 Colt's machine guns
"Y" gun and 12-300 lb. depth charges

### COAST AND GEODETIC SURVEY OFFICERS AND CREW TEMPORARILY IN U.S. NAVAL SERVICE WHO SERVED ON BOARD

Lieut. Commander F. H. Hardy, Sept. 24 to Nov. 5, 1917. Commanding Officer.
Lieut. F. G. Engle, Sept. 24 to Nov 11, 1917. Executive and Navigator.
Lieut. Commander H. A. Seran, Nov. 12, 1917 to Aug. 27, 1918. Executive and Navigator.
Lieut. C. T. Bussell, Sept. 24, 1917 to April 13, 1918. 1st Watch Officer.
Lieut. S. T. Barker, Sept. 24, 1917 to March 31, 1919. 2nd and 1st Watch Officer; Executive and Navigator; Commanding Officer.
Lieut. G. E. Marchand, (M.C.) Sept. 24, 1917 to Jan. 31, 1919. Medical Officer.
Lieut. (J.G.) G. H. Durgin, Dec. 11, 1917 to June 14, 1918. 3rd Watch Officer.
Ensign A. Deritis, Sept. 24, 1917 to March 31, 1919. Boatswain; 3rd Watch Officer.

F. H. Bargmann, Chief Electrician (radio)
F. R. Groshong, Yeoman, first class.
J. B. Farrow, Quartermaster, first class.
Albert Churchill, Quartermaster, third class.
B. L. Johnson, Fireman, first class.
G.S. Brown, Officers Cook.
Sanger Curtice, Electrician, first class (radio)
J. F. Kight, Engineman, first class.
J. L. King, Quartermaster, second class.
L. J. Vess, Coxwain.
Ernest Dreifus, Seaman.
W. B. Powell, Officers Steward.




**Ernest Lester Jones – Director of the Coast and Geodetic Survey. Took leave of absence and served in Europe. Developed photogrammetric techniques which he brought back to C&GS.**
**A founder of the American Legion.**
**Died as result of lingering effects of WWI gassing.**

# World War I Legacy

**Commissioned Service of C&GS**

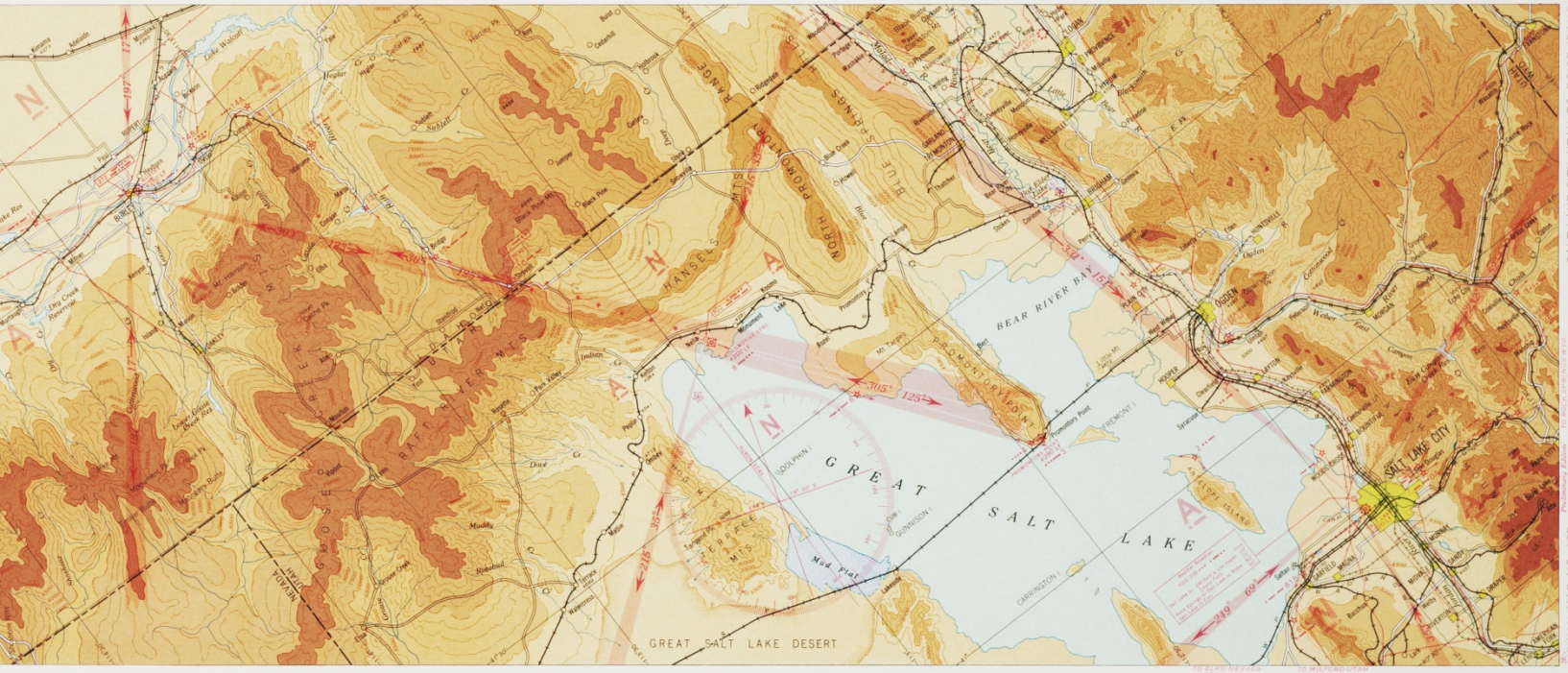
**Flight**

**Photogrammetry**

**Electronics**

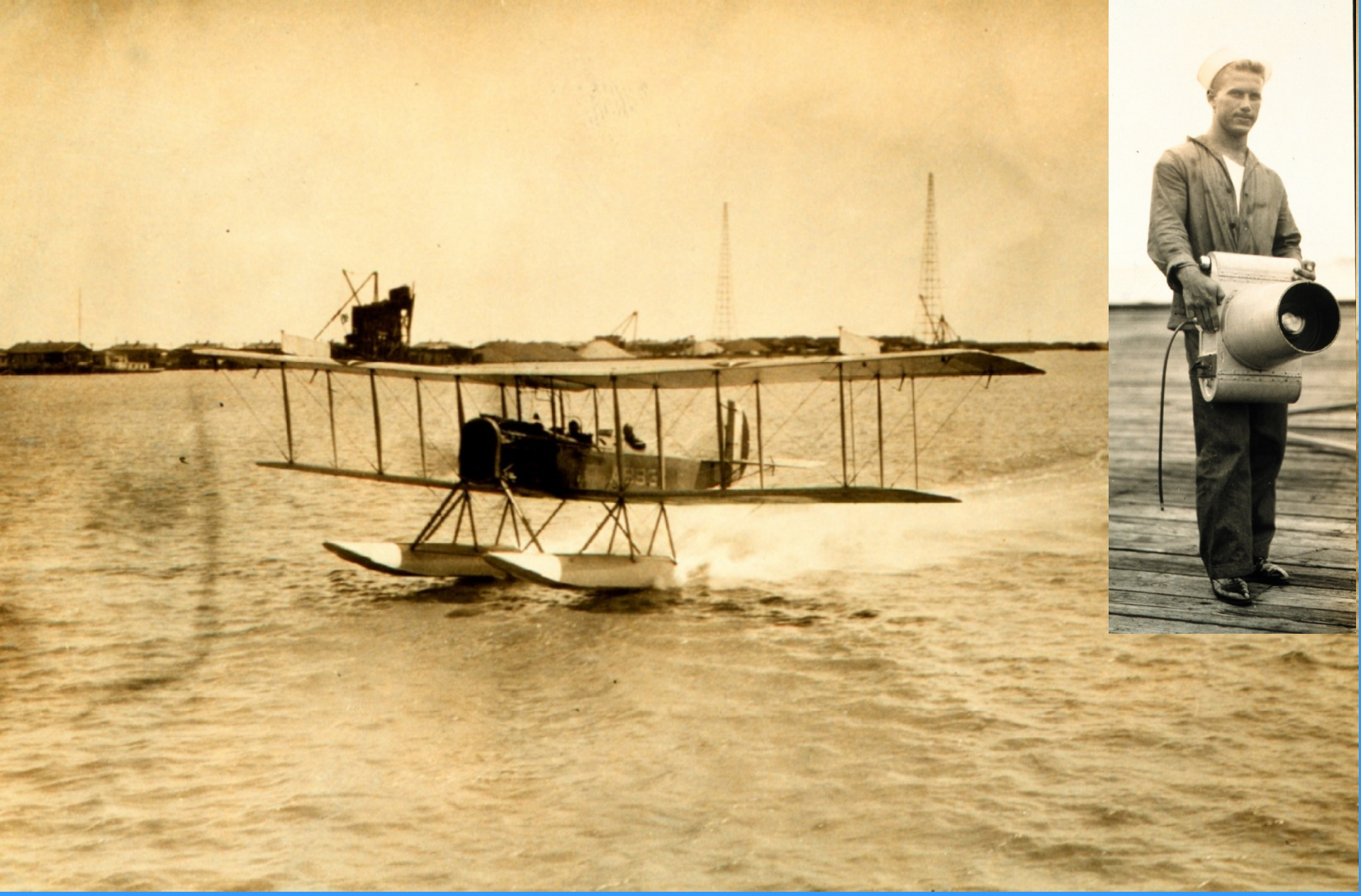
**Ocean Acoustics**

**Modernization of Printing**




# CHARTING THE NATION"S AIRWAYS

**2nd Edition of Salt Lake City to Boise Airways Strip Chart, 1936. Beginning in 1926 under Lester Jones, the C&GS mapped our national airways and developed many of the air navigation products in use today.**



**Navy plane flying photogrammetric mission for C&GS over Mississippi Delta area. 1920. Used single-lens camera.**

**Early five-lens photogrammetric camera being readied for installation on naval aircraft.**

DETAIL ASSURES MAXIMUM USEFULNESS OF BASIC SURVEYS

Portion of planetable survey of the Ten Thousand Islands, Florida West Coast.

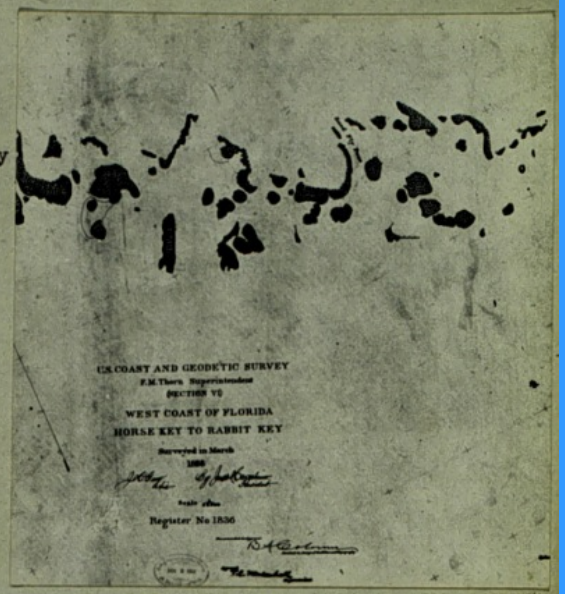
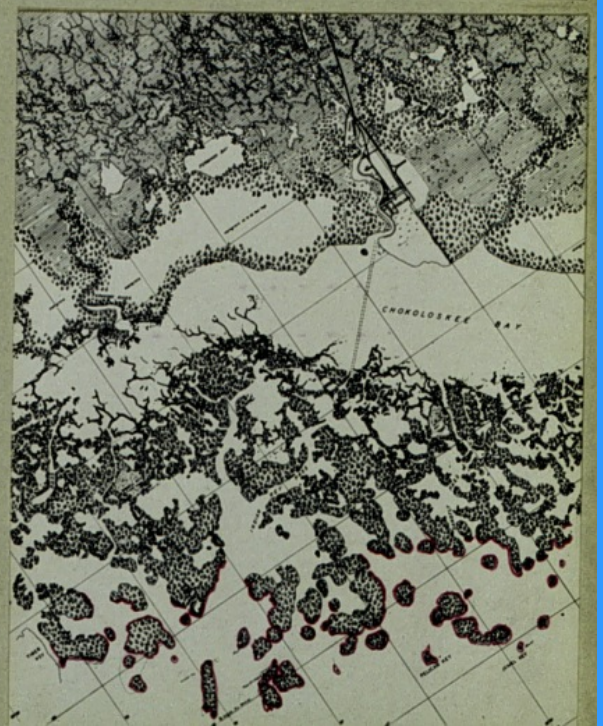



Photo topographic sheet of same section of coast.

Extent of planetable survey indicated in red.




**Photogrammetry – Faster, more efficient shoreline mapping . Top: plane table survey. Bottom: shoreline derived from aerial photographs.**

**1924 C&GS Ships GUIDE , DISCOVER, and PIONEER proceed to West Coast – equipped with sonic echo sounders - conduct oceanographic work for Scripps between San Diego inports- conduct radio-acoustic ranging experiments– George McEwen of Scripps analyzes water samples for salinity helping develop first ocean sound velocity tables- install automatic tide gauge and RAR station on Scripps Pier**

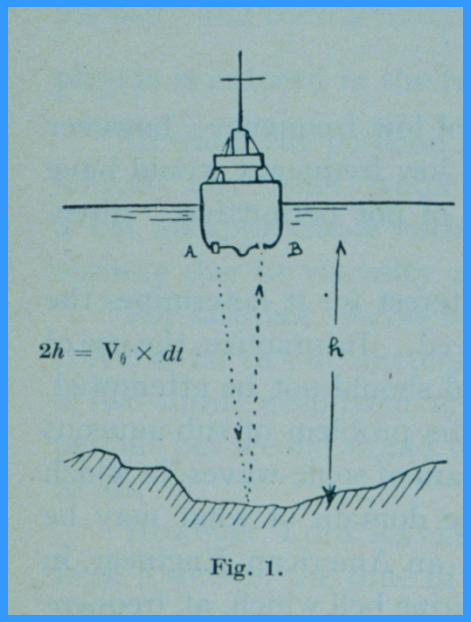
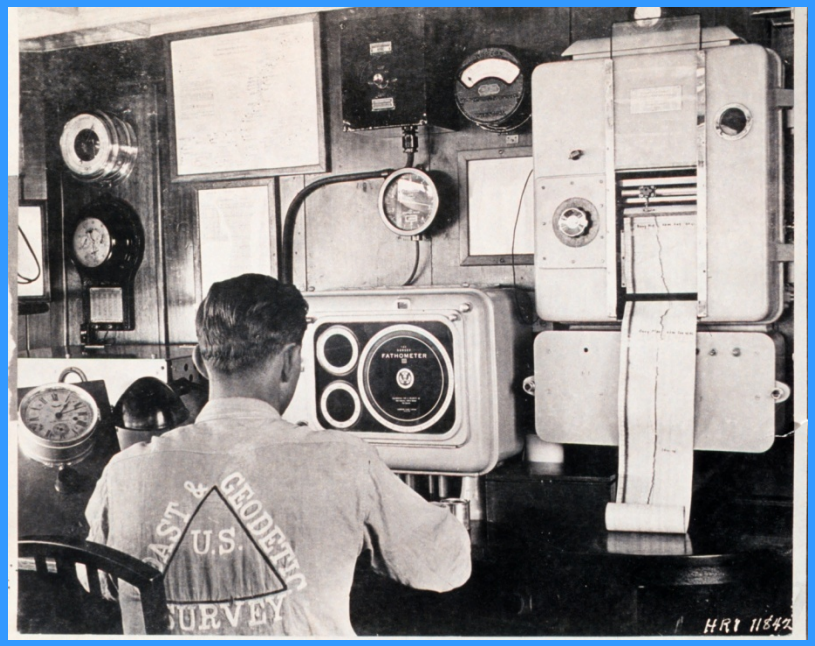
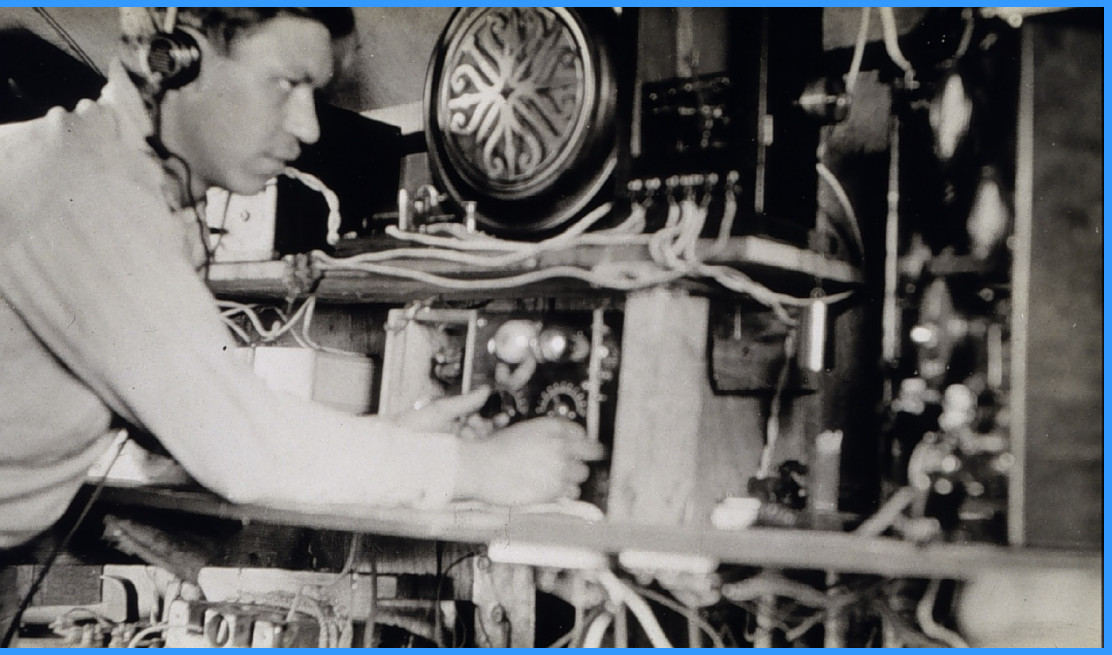
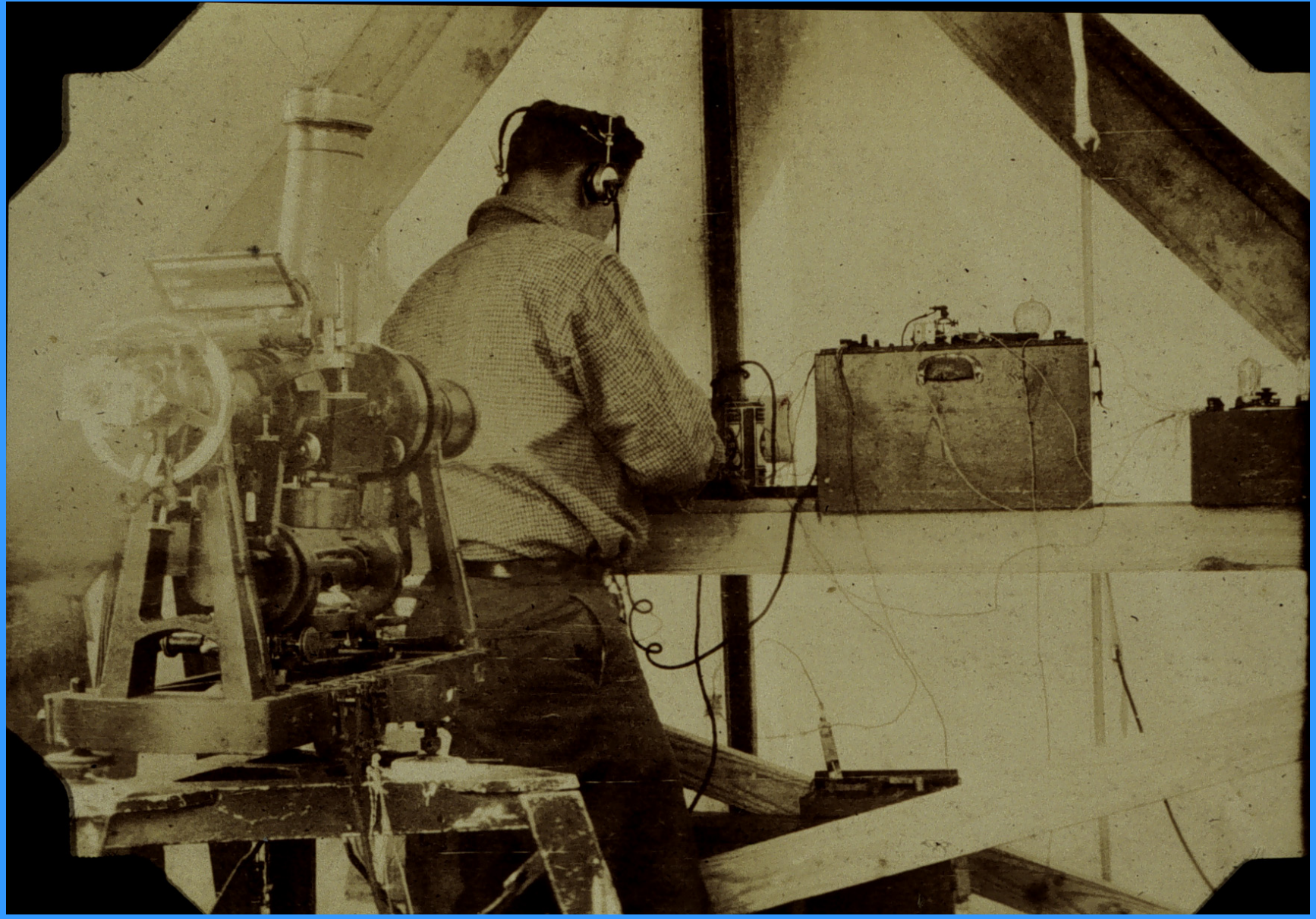


Fig. 1.



# Electronics and Acoustics Revolutionizes Hydrography and Oceanography 1923-1941



**1924 - Lt. Ed Brown's astro outfit. Astro party of E. J. Brown. Schmidt, Texas. Astronomic latitude and longitude for determining gravitational deflection from vertical. Electronics also making its way into geodesy. Radio reception of time signals for longitude determination.**

**Hydrographic survey crew cobbled together by Eoline Hand (pith helmet) from Navy crew. Surveying off Oahu. As a precursor to WW II, Hand's survey boat was nearly hit by a bomb dropped by an aircraft during naval exercises off Pearl Harbor in 1924.**

**Lieutenant Roswell Bolstad demonstrating proper technique for three-point sextant fix on board C&GS Ship LYDONIA, 1928. This remained the primary means of inshore survey navigation and control until the late 1960's when super-high-frequency navigation systems were developed. An accuracy of 5-10 meters on the surface of the earth could be attained with good 3-point fix geometry.**

**Surveying in the Puget Sound area.  Boy, does this look ugly. 1928.**

**During Jones's tenure, the automobile came into widespread use. This markedly increased the efficiency of geodetic operations. The automobile, like the Bilby Tower, became one of the great enabling technologies of geodesy. However, the original form of horsepower was still required occasionally. 1921- crossing the Red River**

**Level crew crossing a stream north of Valdez, Alaska, 1923.**

**1921- Level Party of Fred Joeckel leveling into Glen Canyon, the major Colorado River Canyon above the Grand Canyon.  Today the great Glen Canyon Dam has inundated this area.**

**1927. Mosquito protection in Colorado. Level party of Ensign Glendon Boothe. Gunnison Valley, Colorado.**

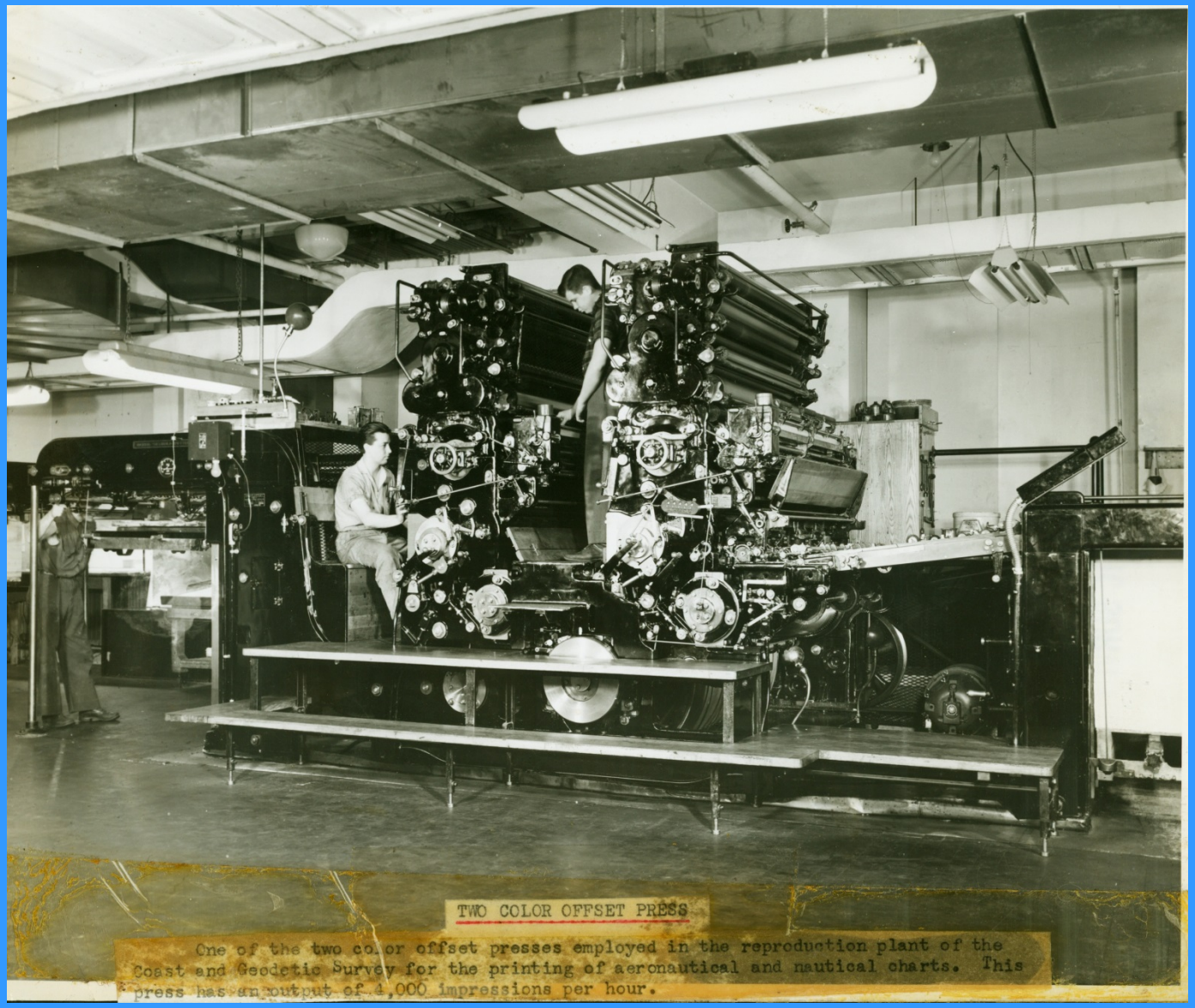
**1928 - Level party at the top of Mount Whitney, California. Level party of John Brittain.**

**1922 - Measurement of the Pasadena Baseline. This baseline was used to determine distance for 1924 Michelson velocity of light measurement. Accuracy of 1:500,000 attained over a 22- mile baseline.**

**Triangulation in Alaska 1923. Station Iquak, survey party off USC&GS Ship DISCOVERER.**

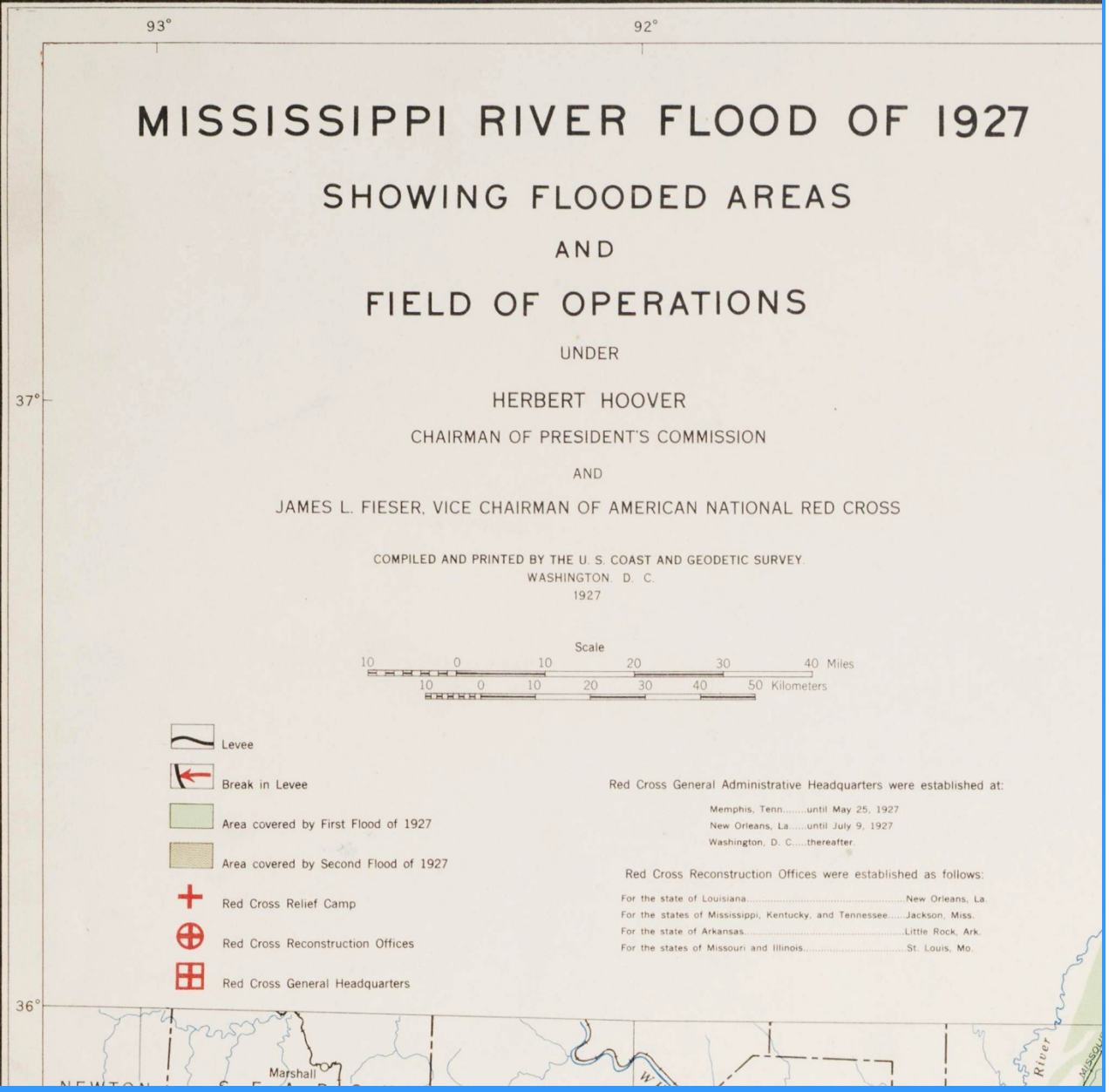
**1924 – Montana. Light used on triangulation work. Observers tens of miles away would measure angles between lights placed over station markers.**

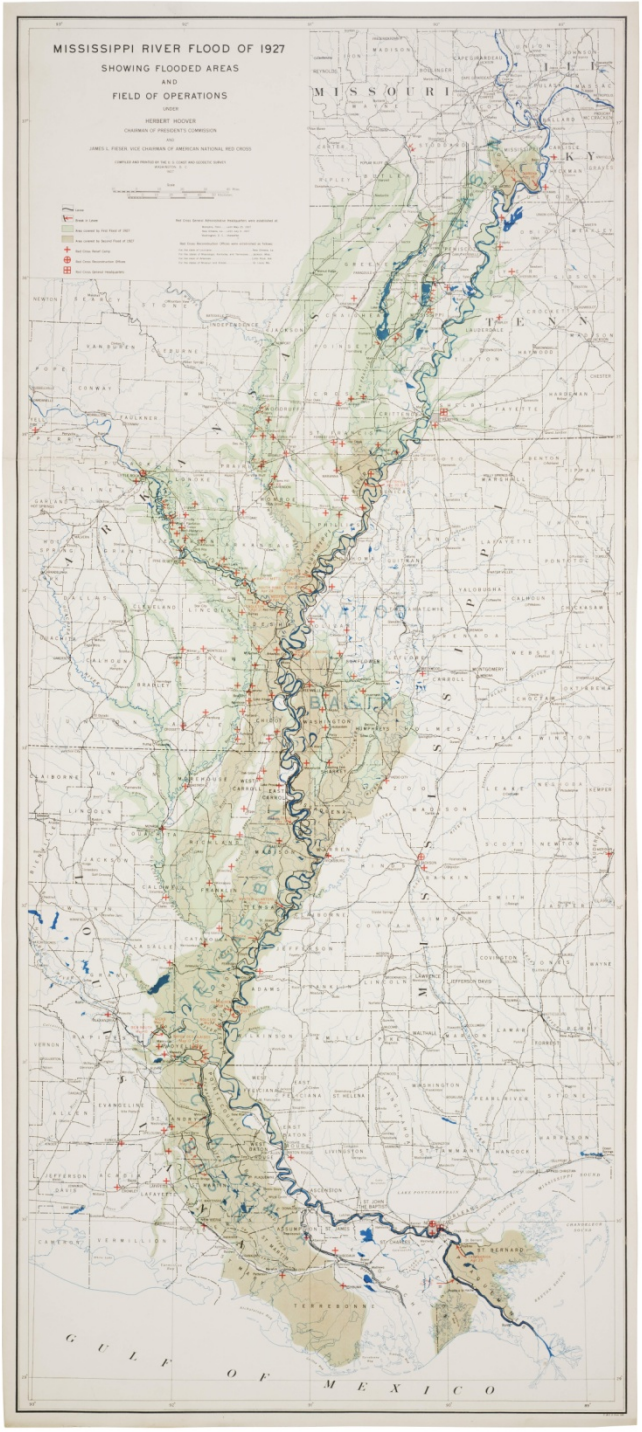
**The first images of a Bilby portable steel survey tower - 1927.**




**Modern printing presses procured and installed during tenure of Jones. Note pride in being one of the C&GS pressmen.**

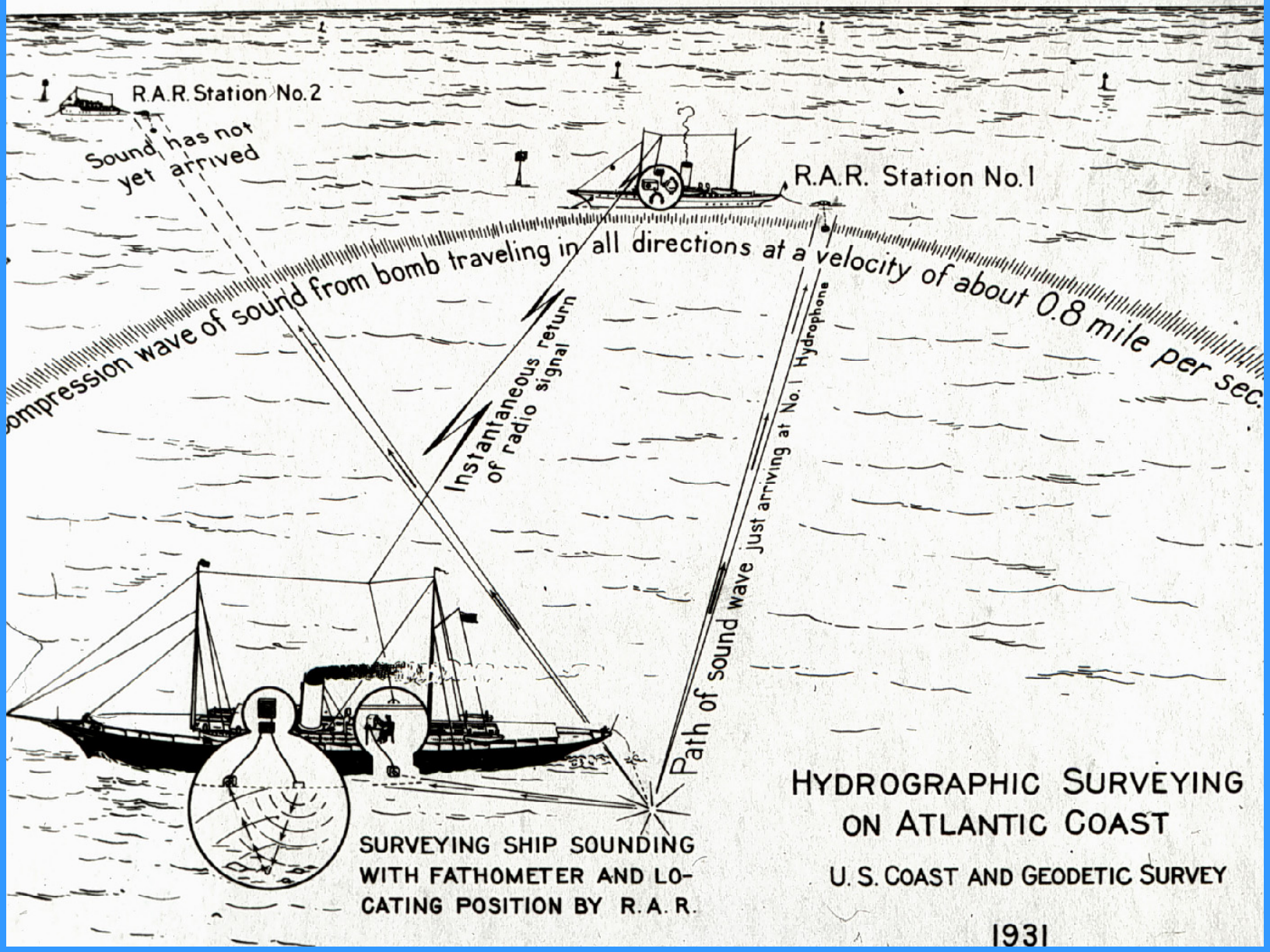
**Disaster Response: Coast Survey boats launched from train flat-bed cars during great Mississippi River flood of 1927. Responding to disasters has been an intrinsic part of our work since at least this great flood.**



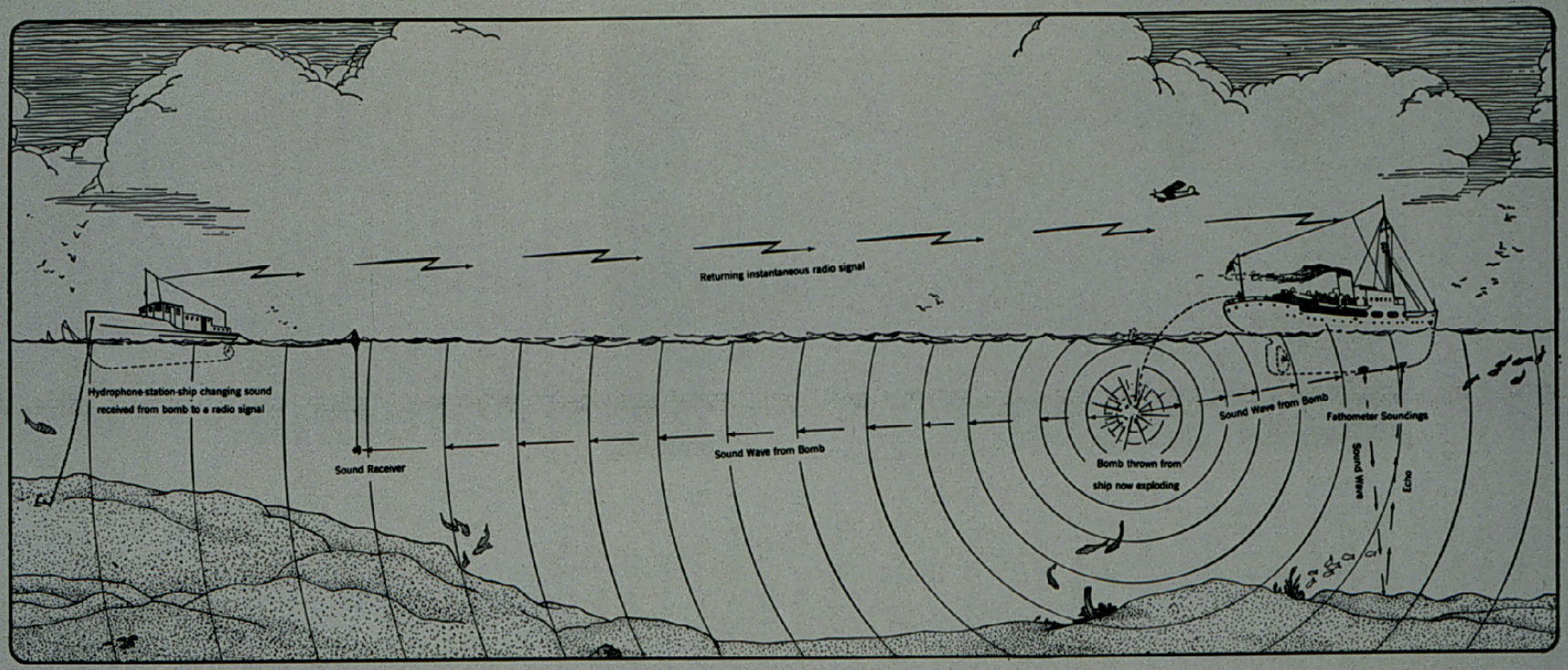




**C&GS mapped extent of 1927 flooding.**

**Raymond Stanton Patton, Director of C&GS 1929-1937. Left image – 1933 with Shore and Beach Preservation Association on New Jersey beach. Right- young ship's officer in Philippines 1908.**



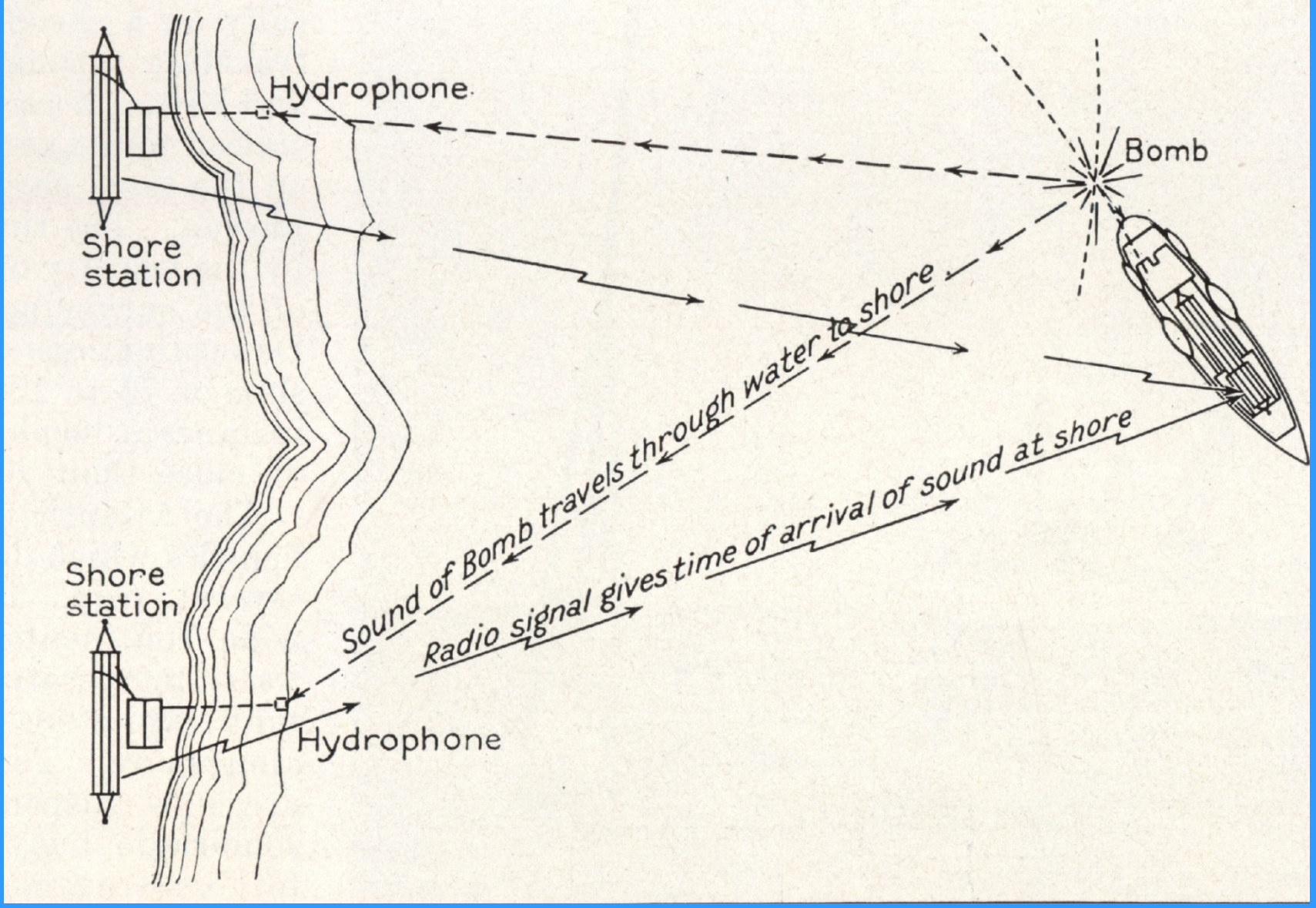

**Radio Acoustic Ranging – First non-visual survey-quality navigation system. Developed under Jones, perfected under Patton.**




*Fathometer Soundings and Radio Acoustic Ranging.*

Showing two of the scientific methods employed by the Coast and Geodetic Survey of the Department of Commerce to insure on nautical charts (1) correct water depths and (2) the precise positions of such depths, many of which are given for water areas far out of sight of land. Depths are determined with a fathometer, which measures the time required for a sound to travel to the sea bottom and return to the ship as an echo. They are made at the rate of 4 per second, while the survey ship proceeds back and forth over the area at her regular speed. The positions of these depths are fixed by radio acoustic ranging, from two previously determined positions, such as two station ships (of which one is shown). The time elapsed between the sound from the bomb as received on the survey vessel, and the radio wave from the station ships, is measured on the surveying ship to one one-hundredth of a second. Knowing the velocity of sound in water, the distance between the survey ship and each of the two station ships can be calculated accurately, even when separated by as much as 100 miles.

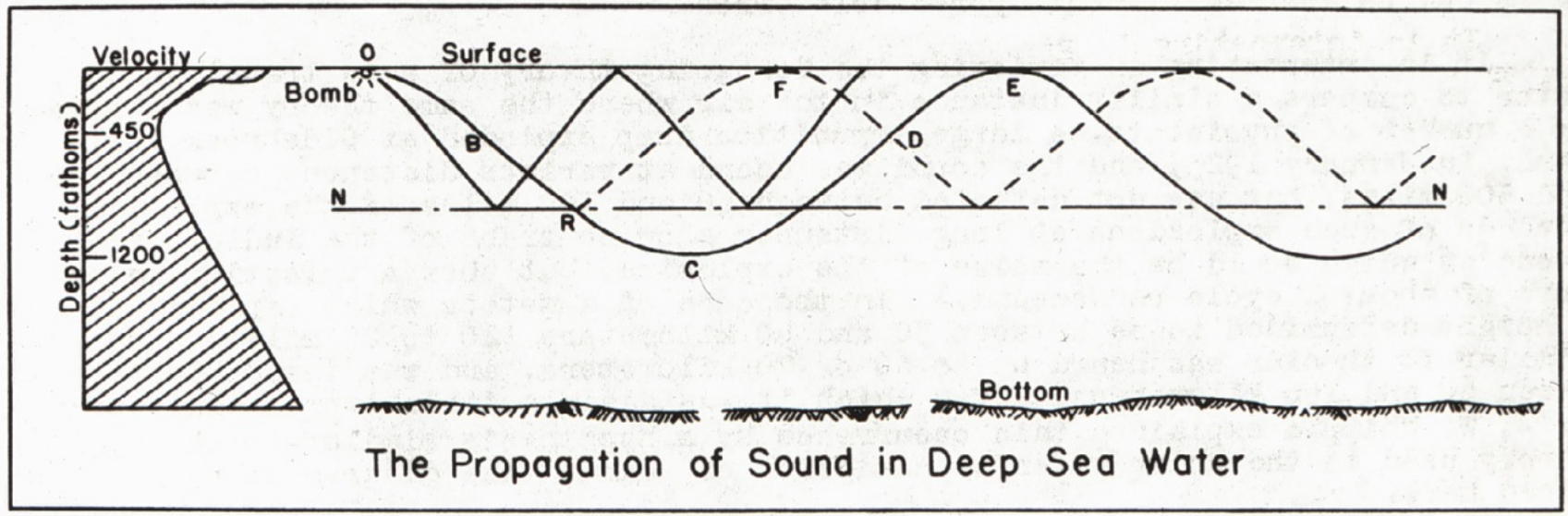
**Radio Acoustic Ranging and Fathometer Soundings combine to survey areas previously controlled only by dead reckoning or astronomic positioning.**




**The elapsed time between bomb detonation and radio signal received at ship times the velocity of sound in sea water gives a range. Two intersecting ranges "fix" the position of the ship.**

TIMING THE FUSE INTERVAL

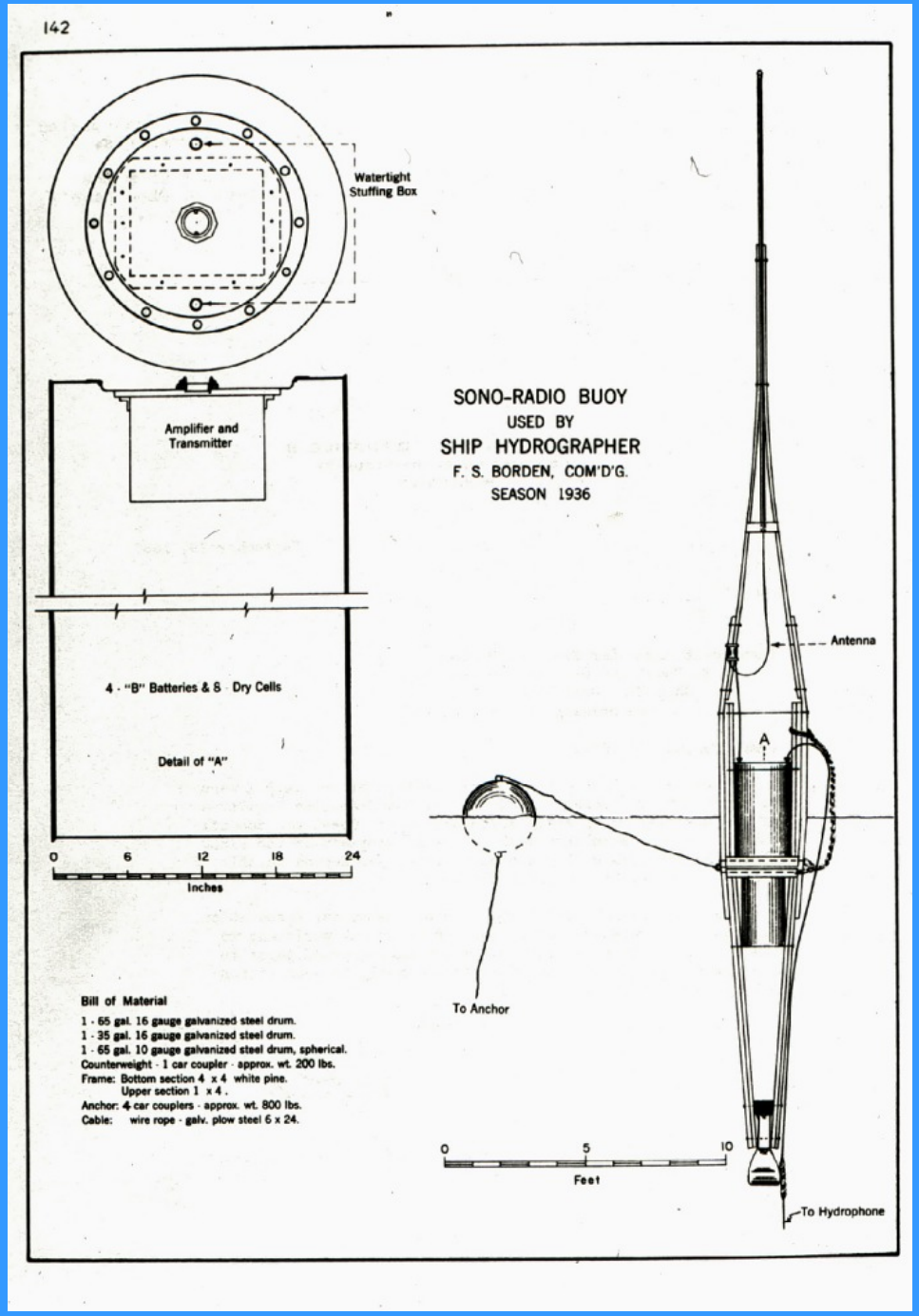
**Radio Acoustic Ranging Bombs were fairly substantial. Up to a quart of TNT would make up some of the bombs. Not one fatality in twenty years of using this technology. However, a few blown up sharks.**



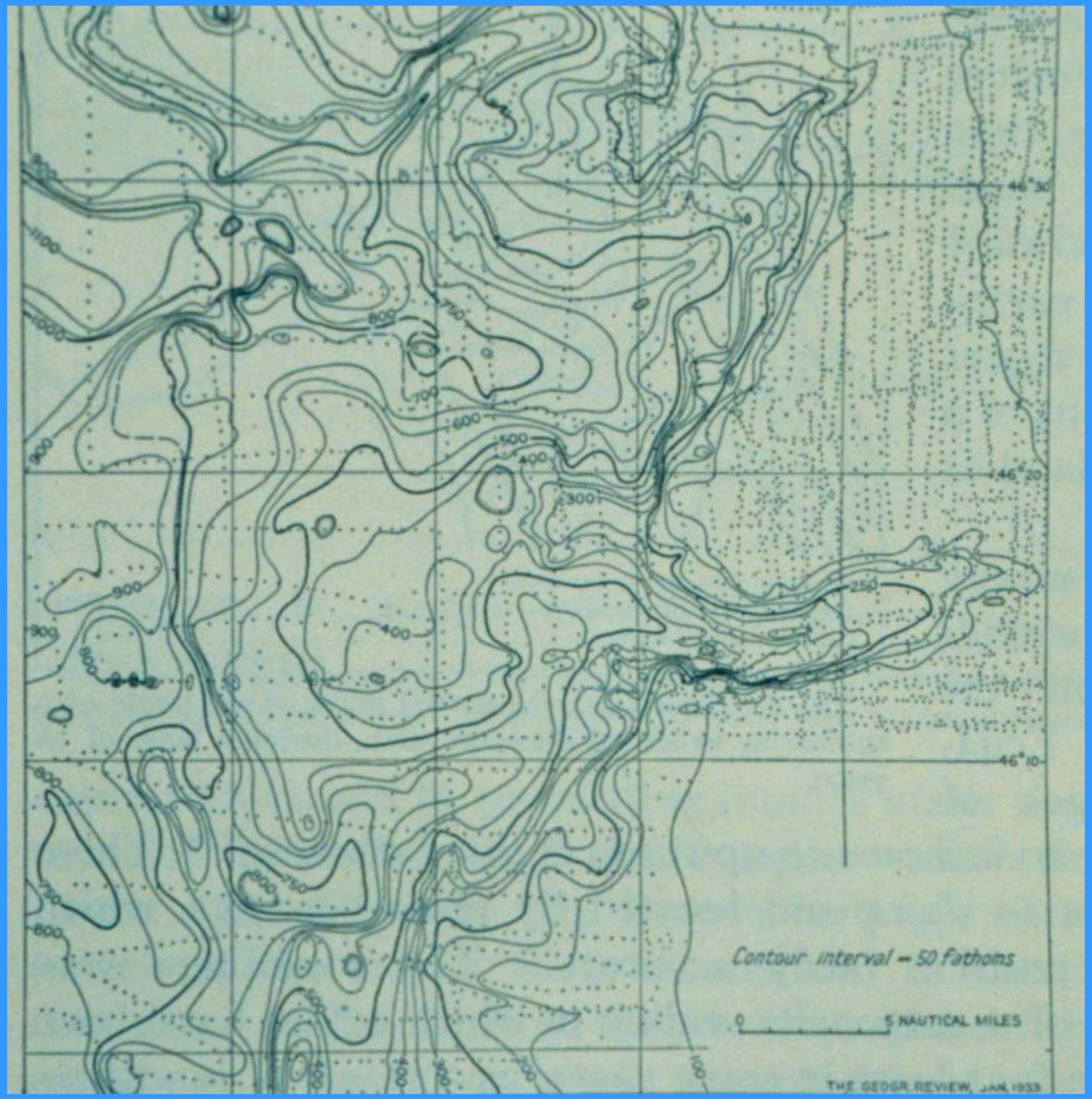
The Propagation of Sound in Deep Sea Water

Figure 6

**The Deep Sound Channel, known as the SOFAR channel after WW II work of Maurice Ewing, was described and defined by the C&GS as the result of Radio Acoustic Ranging experiments. Ewing utilized this channel to invent a means to find and rescue downed airmen during WW II. Use of the deep sound channel formed the basis for acoustic thermometry of ocean climate experiments known as ATOC in the late 1990's.**




**Radio Sono-buoy-**
**This was perhaps the first telemetering oceanographic instrument. It was developed to replace station boats used in radio-acoustic-ranging. The instrument consisted of a transducer suspended from the buoy. When sound waves from the TNT explosion reached the transducer, this automatically keyed a radio response to the survey ship. (Time of radio signal reception minus time of bomb blast) X velocity of sound in water = distance from buoy to survey ship. Two distances from separate buoys would cross and give the location of the survey vessel. Range-Range surveying navigation. The Navy adapted this technology to anti-submarine warfare during WW II.**




**Astoria Canyon by Francis Shepard 1933. Each dot is an individual sounding positioned by use of Radio-Acoustic Ranging. Such detail would have been impossible prior to the invention of RAR and acoustic sounding instruments.**

# CHART 5101A – PROTOTYPE BATHYMETRIC NAVIGATION CHART PRIOR TO ELECTRONIC NAVIGATION

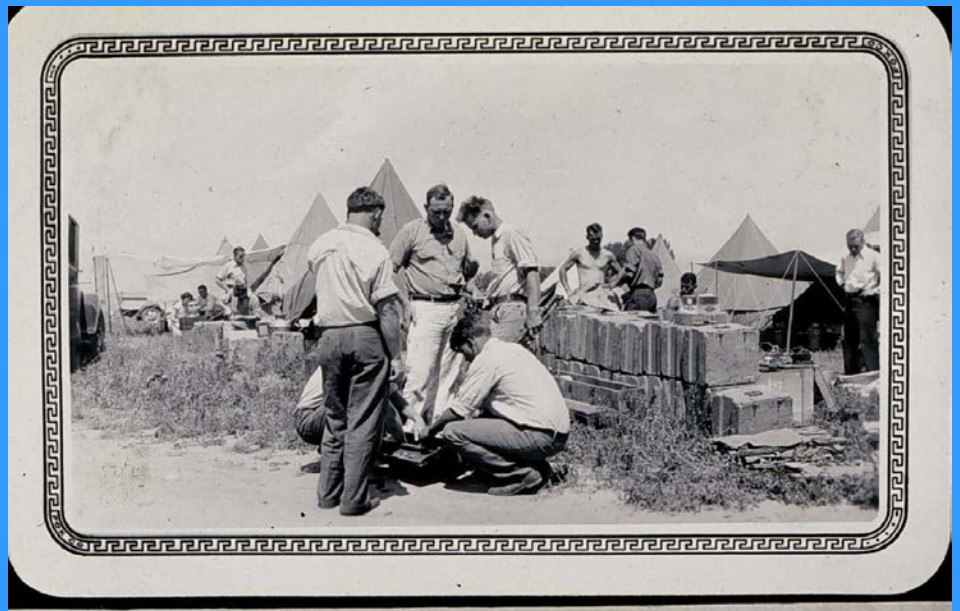
**ORCA signal designed by Coast Surveyors in Taku Inlet. Used for visual hydrography navigation by three-point sextant fix.**

# Additional artwork by white-wash signal painters.

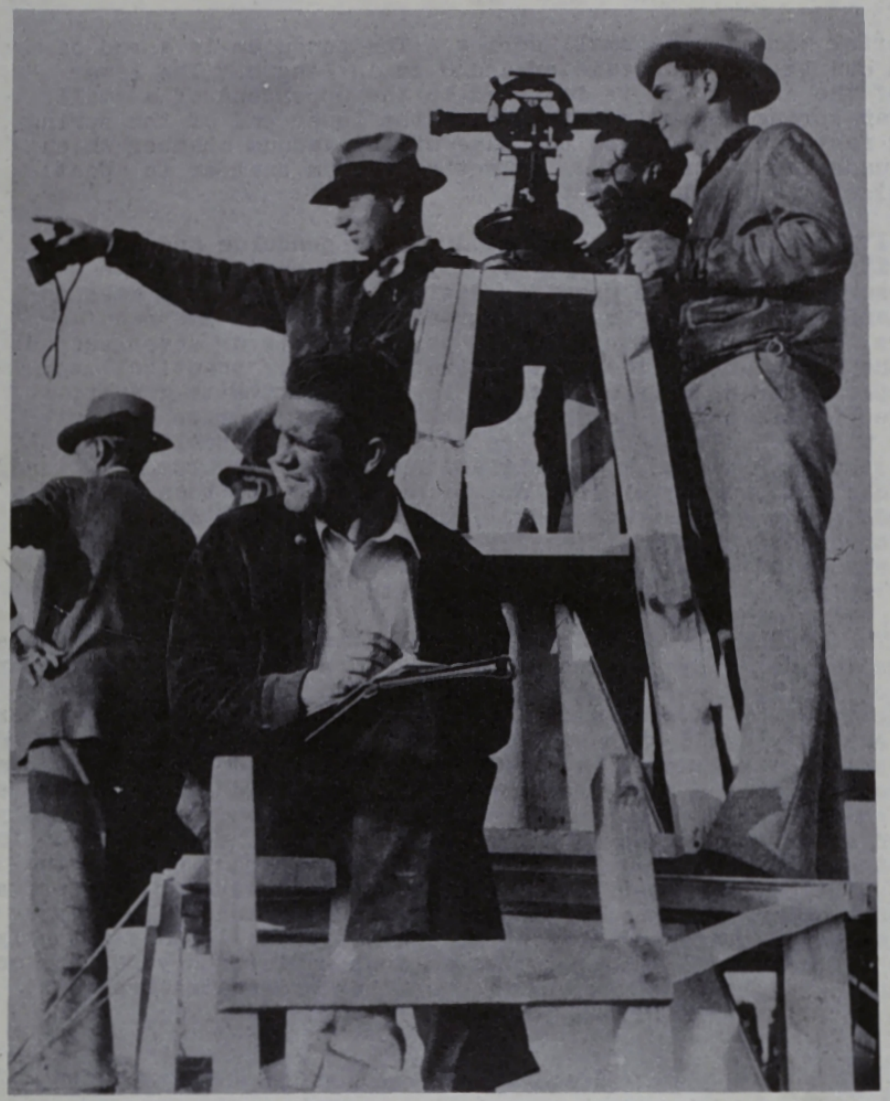
**SEISMOLOGY**

**Long Beach Earthquake 1933 – C&GS begins Earthquake Engineering Laboratory to help mitigate damage to buildings**

**The 1930's Coast and Geodetic Survey – Employer of thousands during the Great Depression - Survey Gypsies an integral part of the American landscape**



Checking-in the equipment at Longmont preparatory to getting the sack. Two days later we were overjoyed at checking it out again.



Triangulation party, Coast and Geodetic Survey, occupying top of Washington Monument, 4:00 p.m., Monday, November 19, 1934, access to which was obtained by using the scaffolding constructed to clean this historic structure. The theodolite is placed on a specially constructed stand over the apex as shown.
-World Wide Photos.

**Many of our Nation's great monuments have been surveyed by the Coast and Geodetic Survey and its descendant organization, the National Geodetic Survey. Here C&GS surveyors are observing angles from an instrument mounted on top of the Washington Monument. 1934.**

**C&GS gypsies on the road with new-fangled trailers - 1935. During the depression years, the C&GS accomplished a huge amount of geodetic work and employed approximately 10,000 men at different times with WPA funding.**

We're on our way to Del rio, Texas.

**Another survey crew on the move – 1934.**

**1931 - Level party trying to stay warm in Washington. Level party of Charles Pierce**

**1934 - George Hastings observing in an Alabama cornfield. Guntersville, Alabama.**

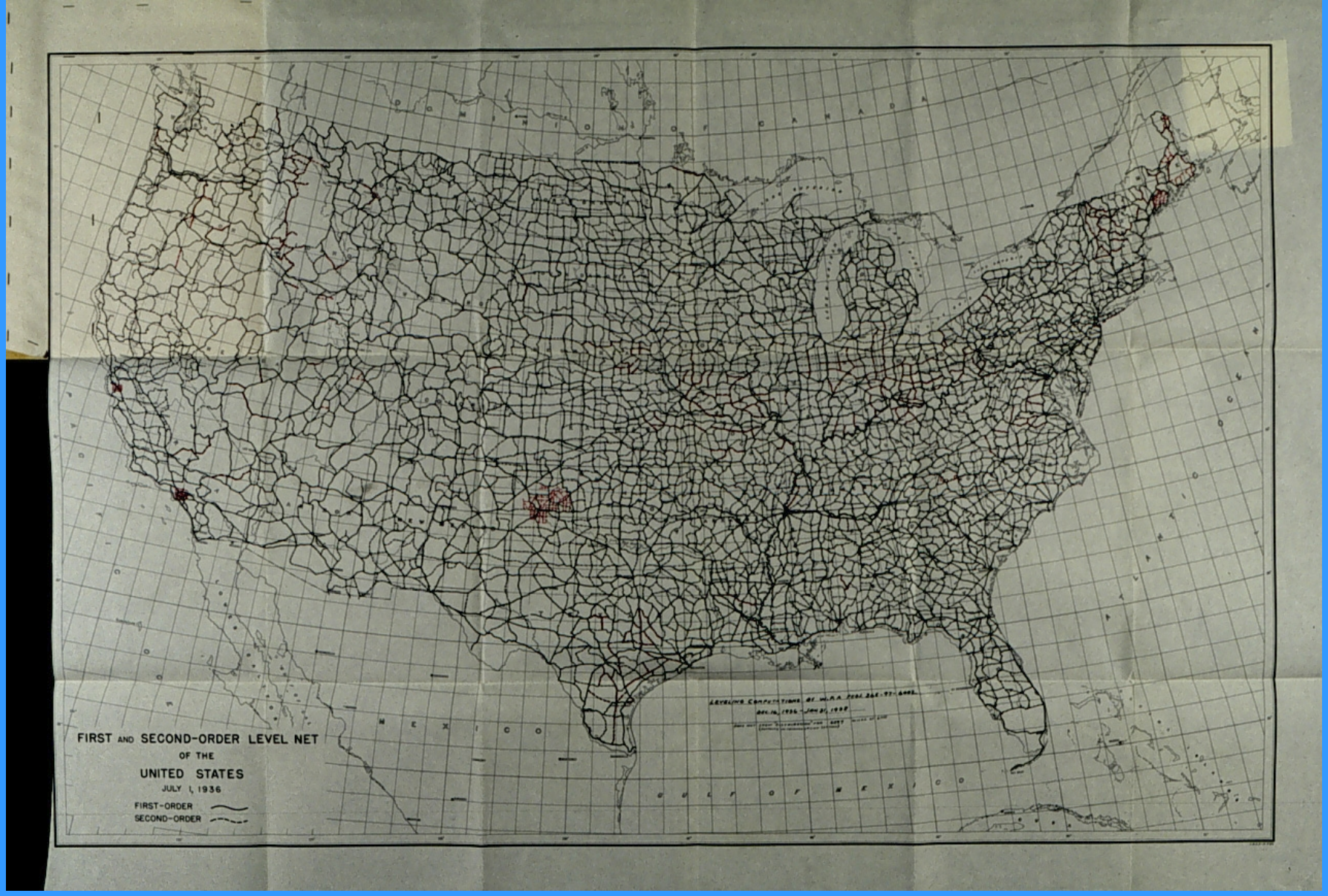
SHADOWS

(Observer on the party of Ensign A. L. Wardwell, leveling across one of the dry alkali lakes in the desert of Nevada.)

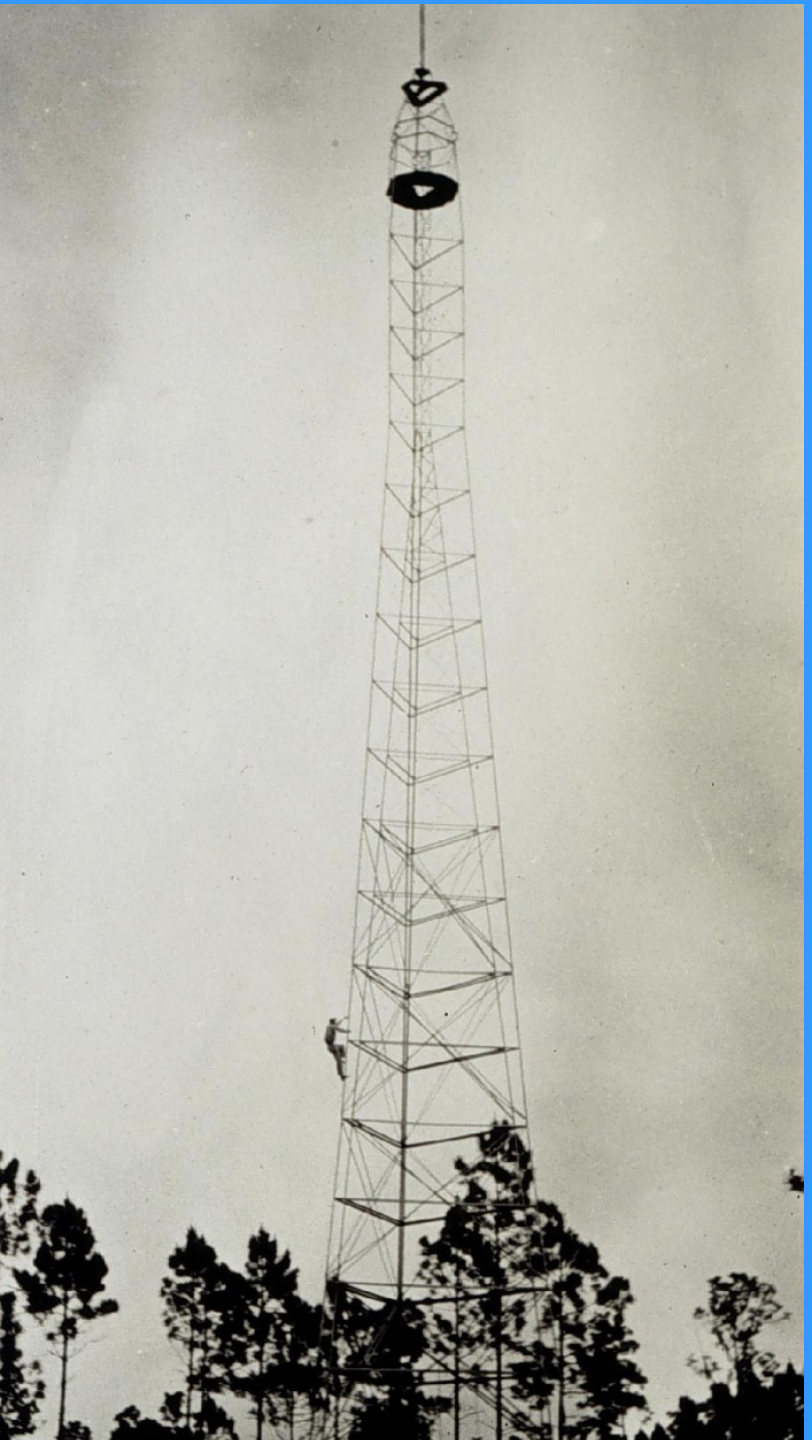
- △ -

**1935 - Desert Shadows. Leveling across a dry lake bed. Party of Ensign Arthur Wardwell. Nevada.**

**1935 - seven observing party level party with its trucks and equipment. Level party of William Gibson. Accompanying families not included in image. Tennessee.**




**The C&GS accomplished thousands of miles of leveling throughout the United States in order to put the nation on a common sea level vertical datum during the 1930's.**



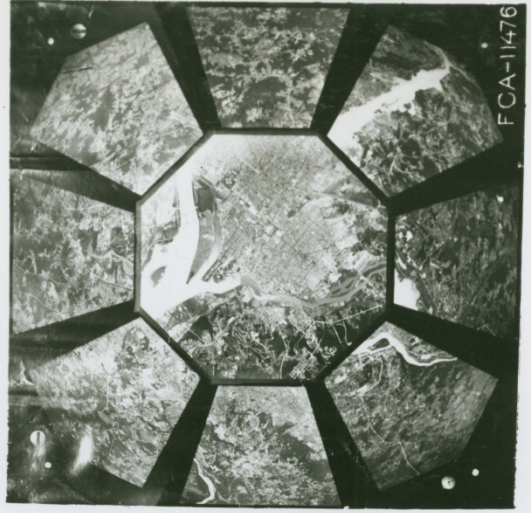
**1935 - Station Hunter - 159 feet - one of the biggest Bilby towers. Triangulation party of Kenneth Crosby. Florida. Thousands of horizontal control points were observed upon by the C&GS during the depression years as well.**

**The C&GS completed much of the national horizontal positioning network of triangulation points during the Great Depression.**

**Black Sunday – April 15, 1935, Stratford, Texas. This picture was shot by Coast Surveyor George E. Marsh. It has become quite famous and even shot into space on a satellite as part of a group of silicon-disk inscribed photos depicting the Twentieth Century.**

**Coast and Geodetic Survey triangulation crew being filmed for documentary ca. 1935. Public affairs and education has always been an intrinsic part of our work.**

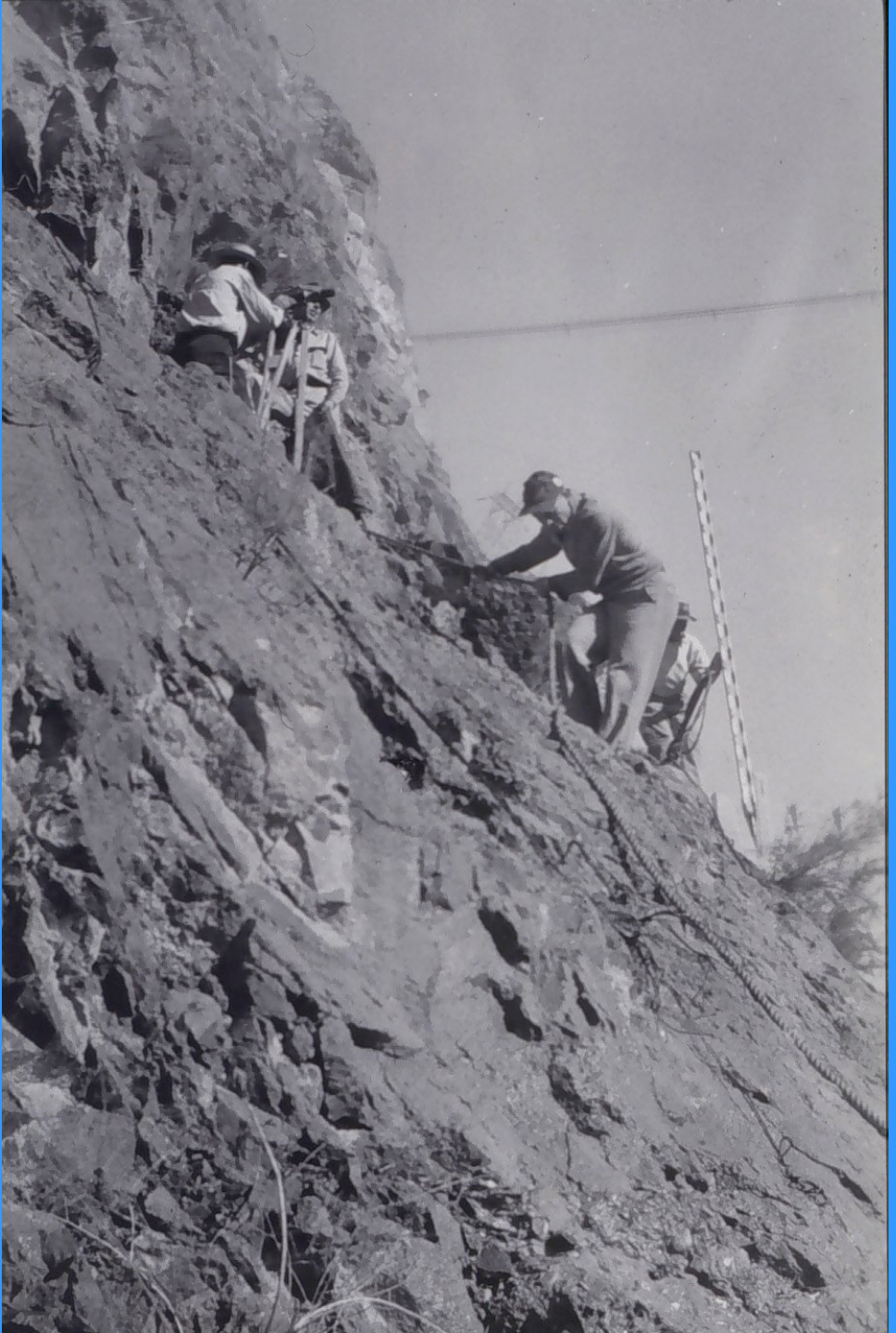
**Leo Otis Colbert, Director 1938-1950. Colbert directed the activities of the Survey throughout World War II. He was also a trustee of the Woods Hole Oceanographic Institution and the Nation Geographic Society.**



Reduction of a nine lens camera photograph as taken with the aerial camera of the Coast & Geodetic Survey. The top photo represents the contact print from the negative, and the bottom photo represents the transposed view.

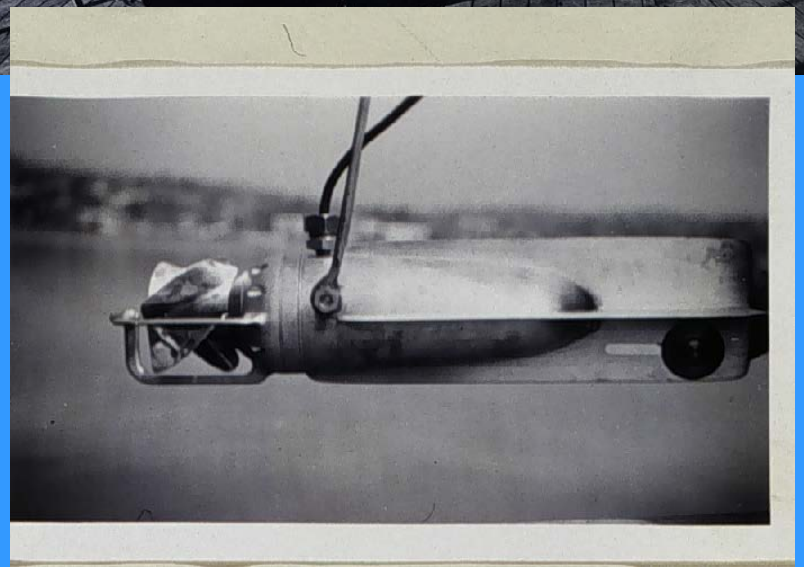
**Nine-lens camera developed by Lieutenant Oliver Reading, USC&GS. First installed and used in 1938. This is an image of Washington, D. C.**

**1940 -Level crew wading through swamp after cutting path through brush. Tough work!  Louisiana?**



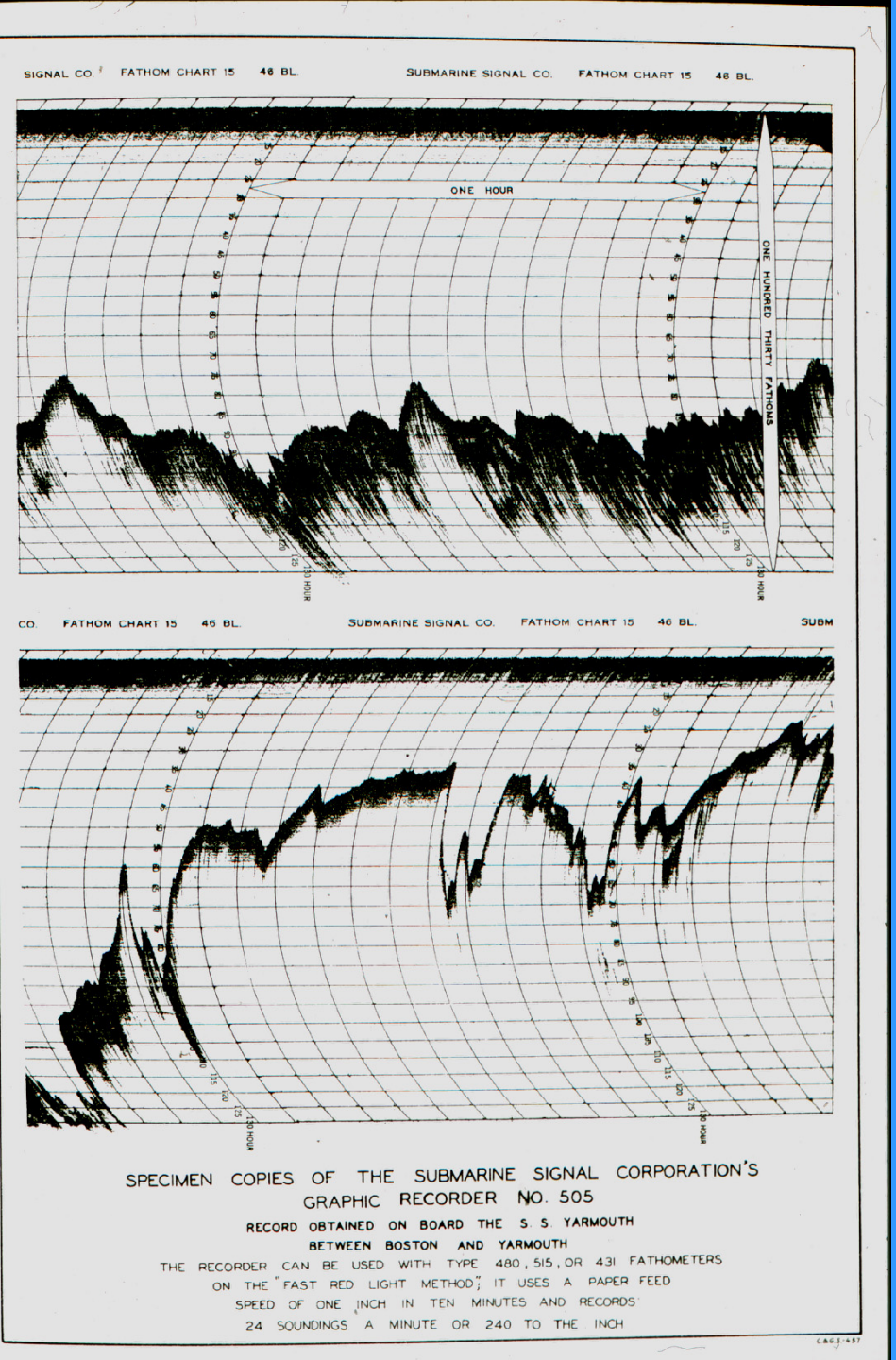
**1941 - Leveling on the "low line" at Hoover Dam. Level party of Emmett Sheridan**

# 1942 Roberts Radio Current Meter – First telemetering instrument to measure an oceanographic parameter from an anchored buoy.



Lieutenant Commander F.R. Gossett and Chief Petty Office Savage operating equipment aboard the U.S. Coast & Geodetic Survey ship "Oceanographer".

**Although the Survey was gearing up for war, Hydrography, Geodesy, and Topography all continued as normal up to the beginning of World War II.**




**It was not until the late 1930's that the C&GS adopted the use of recording fathometers. As opposed to one leadline sounding every minute or so while progressing along a survey line, this technology gave up to 240 sounding per minute that were recorded in a continuous profile of the seafloor.**

# WAR CLOUDS GATHERING

**In January 1915, Assistant Eoline Hand (the Coast and Geodetic Survey was not to become a commissioned service until 1917) while conducting surveys in the Hawaiian Islands wrote of his concern with manifestations of Japanese nationalism that he had witnessed from Japanese hired on his party. Hand reported that as they " gathered about the nightly campfire the burden of their boastful conversation was of that time when the red sphere on a white field would float pre-eminent from every Hawaiian flagstaff."**

**"....If it were not for the war clouds of Europe, I would feel a lot better....H. and M. [Hitler and Mussolini] are certainly raising hell and God only knows what will be the end. War seems terrible and so does abject subjection. I guess we are on the threshold of a great shift in the world scene. None of us can escape the consequences." Commander Richard Lukens to Lieutenant Paul Smith, April 1939.**

**"It seems silly to talk about science in general when the world is burning up. You are doubtless surrounded by urgent demands of a vital character, and the eyes of this part of the smoking globe are turned in your direction for the next outburst. If it comes out there , however, most authorities I know seem to feel it will be a comparatively simple matter to straighten out.... But the outcome of the mess we find ourselves in cannot be predicted by you and me; and I suspect that many others who prophesy loudly may not, in their own hearts, be so sure of their spoken prophesies.“ Lieutenant Paul A. Smith to Commander Richard Lukens, Director of Philippine Coast and Geodetic Survey. February, 1941.**

**Next Installment: WW II**

**THANK YOU!!!**

# NOAA History Resources

NOAA HISTORY

A Science Odyssey

**http://www.history.noaa.gov/**

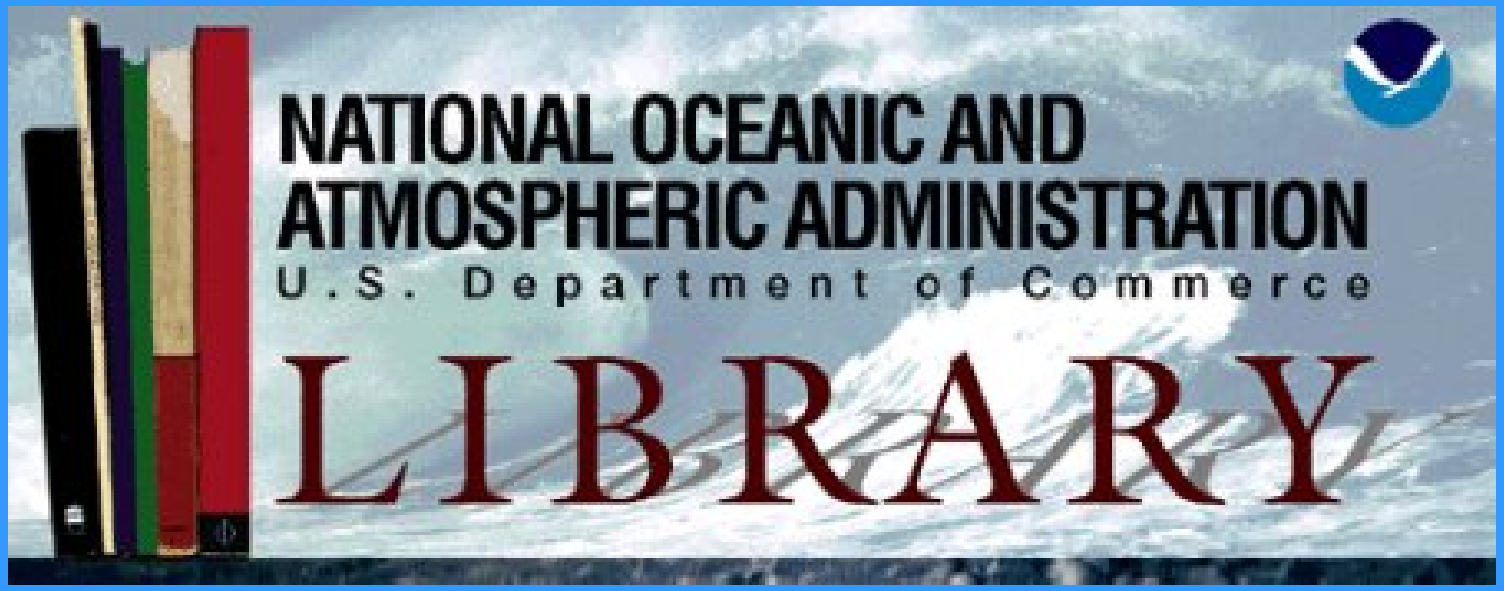
NOAA Photo Library

**http://www.photolib.noaa.gov/**

ocean explorer/History

**http://oceanexplorer.noaa.gov/history/history.html**

# NOAA Central Library

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