



2026

SURVEYORS'
Conference

**The Darling Line
And Four Corners
Don Teter, PS**

JANUARY 11-14, 2026 | HERSHEY, PA

*Sometimes GPS and Math
Ain't the Answer*

**Why Precise Geodetic Surveying Can't Tell Us
Exactly Where Four-Corners is Supposed to Be,
And Why it is Exactly, Though Not Precisely
Where it is Supposed to Be**

1.5 pdh

**Presented by: Don Teter, PS
Fairmont State University**

The Darling Line

Putting it in the wrong place,

Which became right;

Moving it to the right place,

Which was wrong;

Then putting it back

In the right wrong place.

New Mexico v. Colorado

267 U.S. 30, 1925 – 1960



Who Was Ehud Darling?

Born 1832 in Vermont, the oldest of 10 children,
moved to Minnesota Territory in the 1850's.
By 1856, aged 23, was a contract surveyor for
the General Land Office.

Joined 8th Minnesota Infantry in 1862,

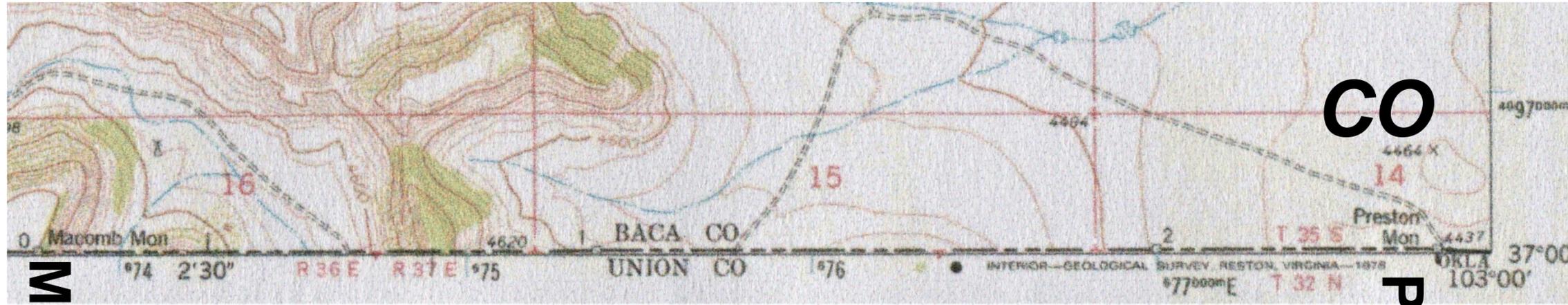
In 1864 became a 1st Lieutenant in the 18th
Regiment U.S. Colored Infantry.

(Fred Roeder, *American Surveyor*, March 2009)



Who Was Ehud Darling?

**Died June 1912,
buried in Arlington
National Cemetery.
According to his sister
his estate had a value
of \$23, including some
furniture and his
compass.**



Macomb

2.5 miles +/-

CO

Preston

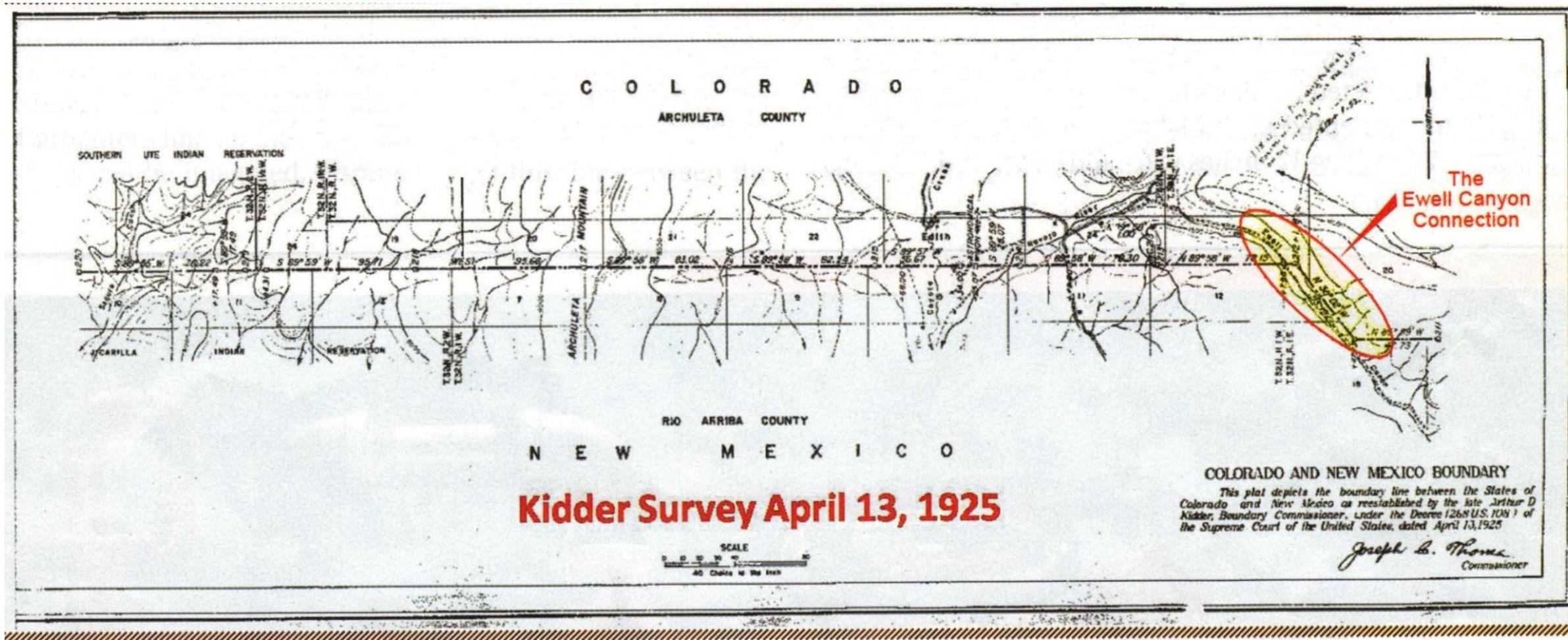
NM
OK

Furnish Canyon East Quad, 1978

The Ehud Darling Survey, 1868

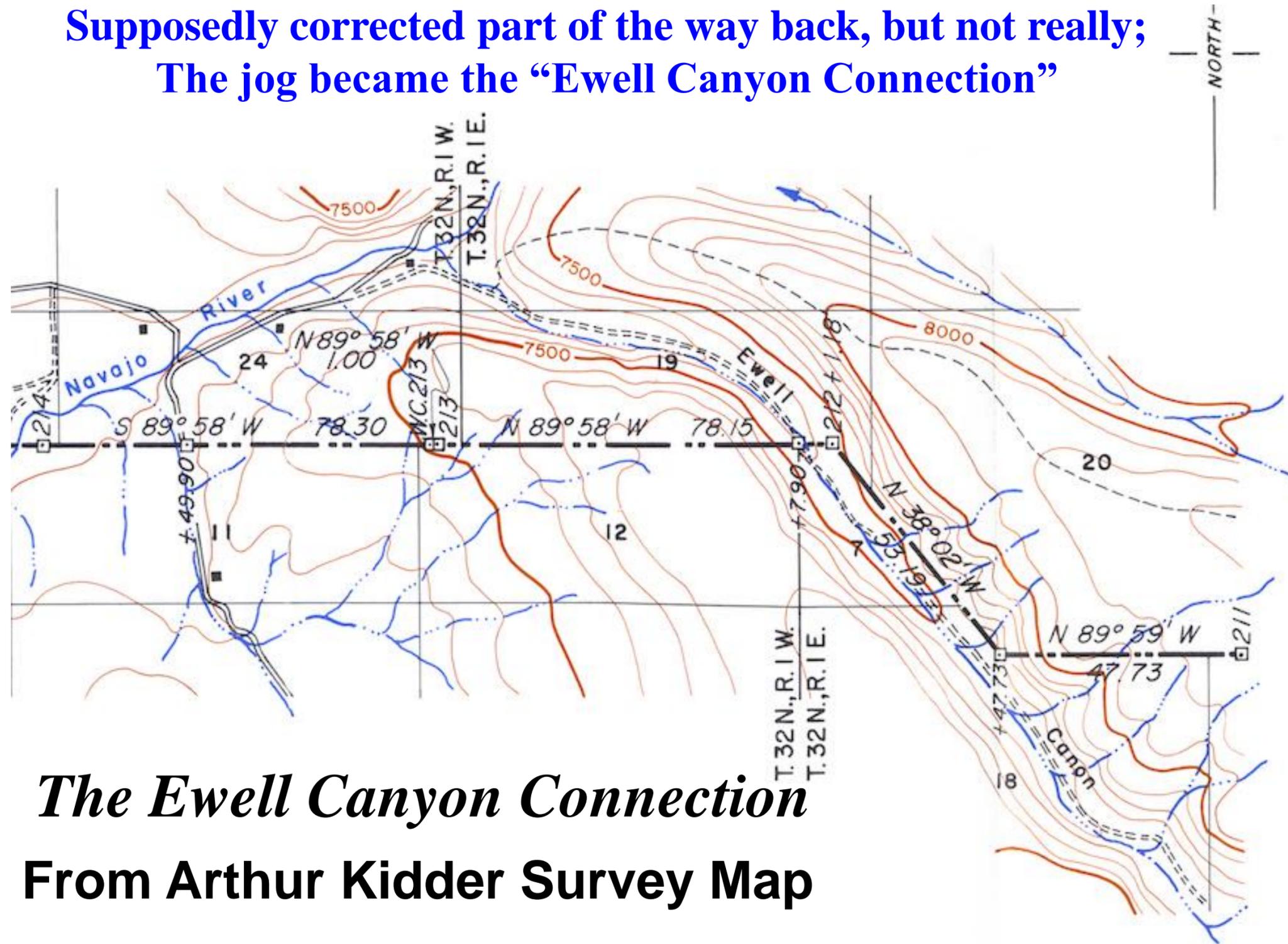
Running the 37th parallel of latitude from Macomb's Monument (1859, near NE corner of New Mexico)

To the 32nd meridian of longitude from Washington, DC

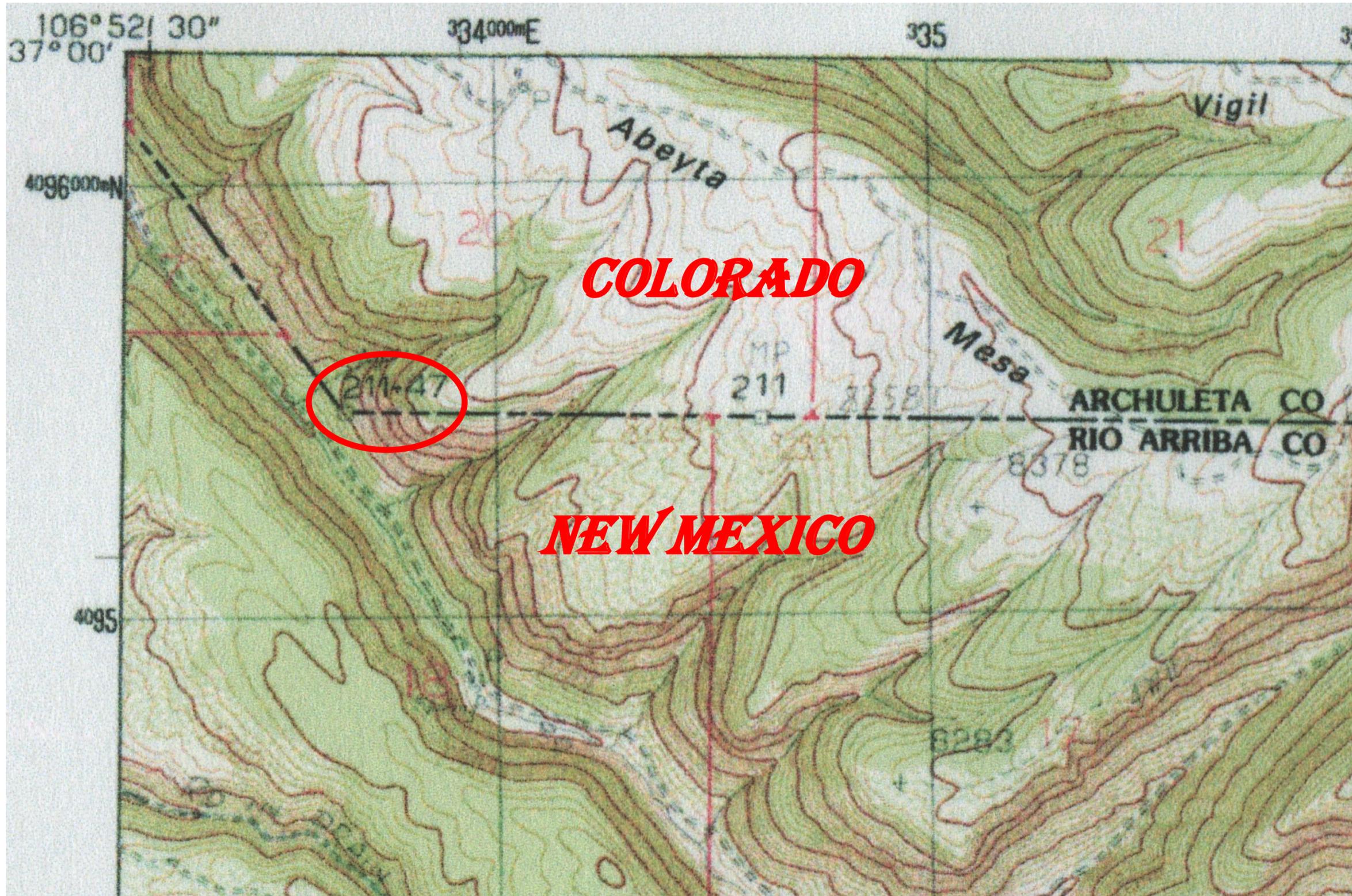


*Retracing Colorado's South Line
by Earl F. Henderson, PLS
Professional Surveyor, July 2010*

At 211 miles 70 chains hit Ewell Canyon, sighted across,
Took observations, corrected 2/5 mile to North (still not enough);
Supposedly corrected part of the way back, but not really;
The jog became the “Ewell Canyon Connection”



The Ewell Canyon Connection
From Arthur Kidder Survey Map



Monero Quad, 1983

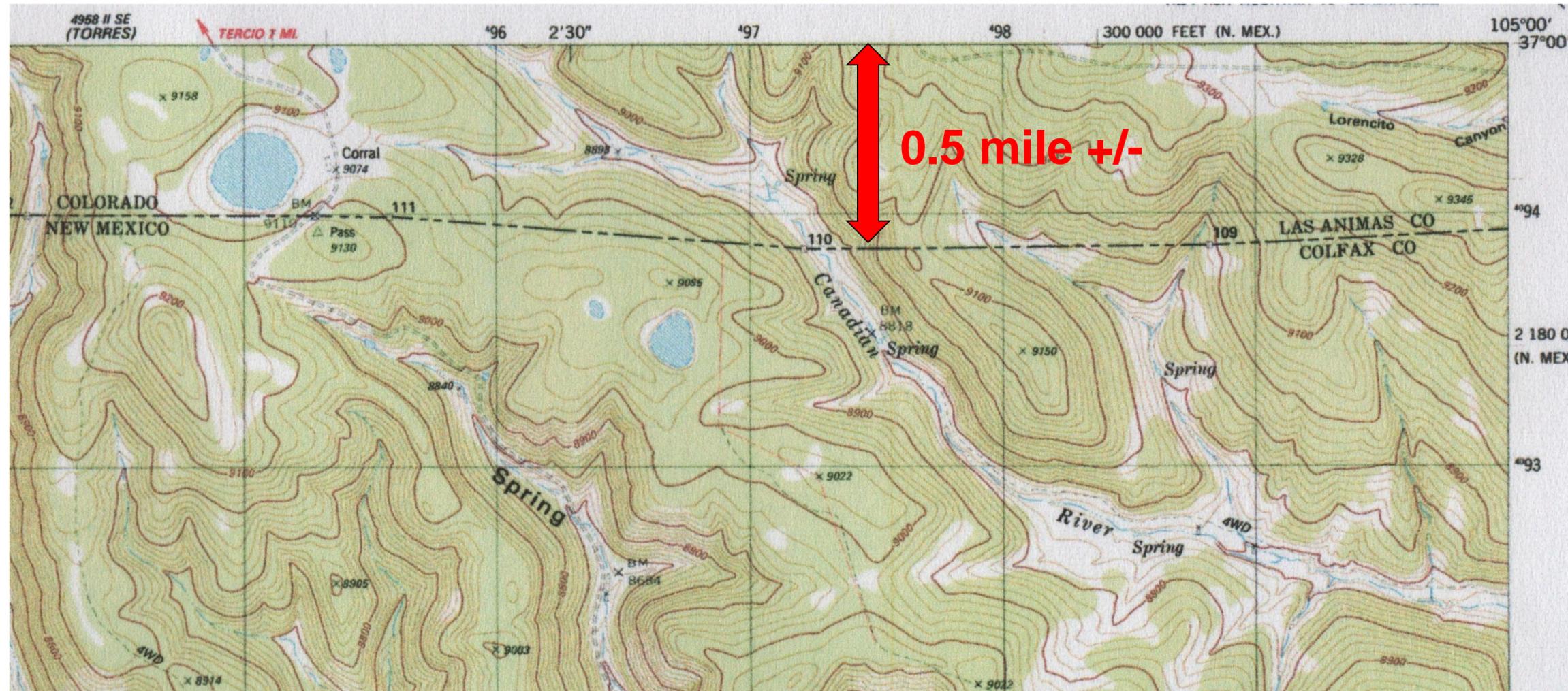


Monument 211+47.73,
c. 1925



It Wasn't Just a Steady Misalignment Issue, They Connected Astronomic Observations

101.6 miles to Ewell Canyon
230+/- to 4 Corners ← → 110 miles to Maccomb Mon.



Vermejo Park Quad, 1986

The Astronomic Stations

Darling called himself “Surveyor & Astronomer” but most of the astronomical observations and calculations were made by his assistant, Professor John Weissner with a total of eleven astronomic stations. Those stations were then connected and the lines between them marked for a total of 331 $\frac{3}{4}$ miles, except a 24 mile stretch northwest of Aztec which was too rough to survey.

(Roeder, *American Surveyor*)

MOVING IT TO THE RIGHT PLACE, WHICH WAS WRONG

Howard B. Carpenter Survey, 1903

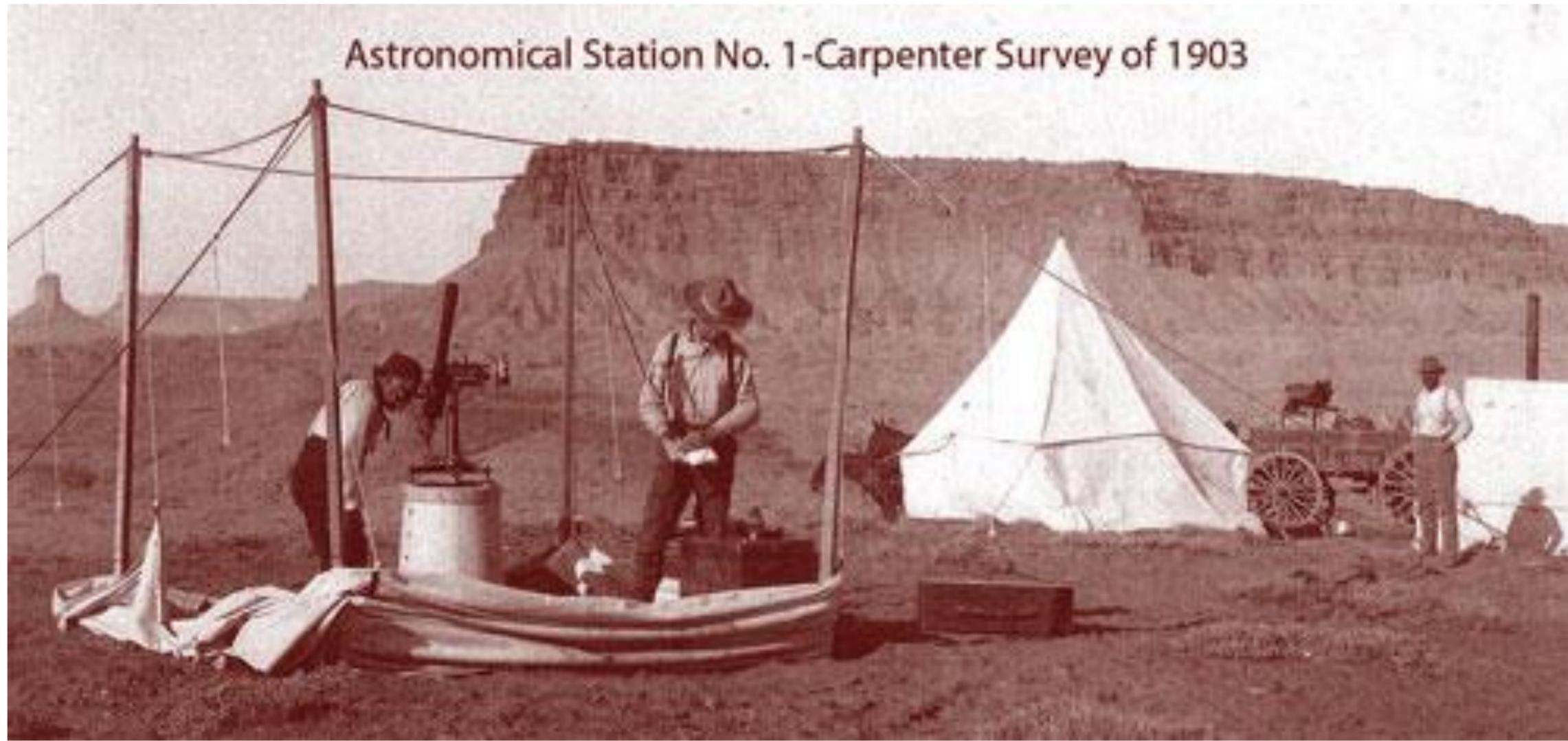
GLO 1902: Darling's line was vague and wrong,
GLO had Carpenter survey the "right line",
and "obliterate" evidence of Darling's survey,
(but he located the positions first).

New Mexico stood to gain a large strip of land.

1904-1908, GLO recognized the Carpenter line.

1908, Congressional joint resolution recognized
Carpenter's line, but President Teddy Roosevelt vetoed it;
and the GLO abandoned Carpenter's line.

Astronomical Station No. 1-Carpenter Survey of 1903



The Lawsuit

New Mexico sued in 1919 to get the Carpenter Line;

In 1925 the Court ruled that Colorado had
“exercised dominion and sovereignty”, and
“the recognized and accepted boundary”
is the Darling Line, noting that:

There is some evidence ... as to the relative correctness of the location of the line of the 37th parallel as established by Darling, (et al) ... and by Carpenter. It may well be that neither is entirely correct. We have no occasion, however, to determine this question, or to settle the precise location of the parallel line as an original matter, since, upon the uncontradicted facts, it is entirely clear that the line of the parallel as surveyed and marked by Darling westwardly from the Macomb monument, ... must be now taken as the established boundary between the two states.

The Kidder Survey

In 1917, William C. Perkins retraced part of the Darling Line.

In 1925, Arthur D. Kidder was appointed Commissioner to restore the Darling Line, using Perkins' work and retracing the rest, using Darling's and Carpenter's notes;

Restoring the Darling monuments that Carpenter obliterated, and obliterating the Carpenter monuments

Thus:

Putting it back in the right wrong place

Somebody Pay the Man

In 1925 the Supreme Court ordered the states to share the costs of Kidder's survey.

He didn't get paid and refused to release his plats and notes.

In 1959, his widow was paid, and the data was released and officially finalized (per Henderson).

364 U.S. 296 (1960)

The report of Commissioner Joseph P. Thoma (acting under the decree of April 13, 1925) was filed June 27, 1960, and affirmed Oct. 24, 1960.

The Four Corners Monument

Putting it in the “wrong” place,

Which was right;

And correctly

leaving it there;

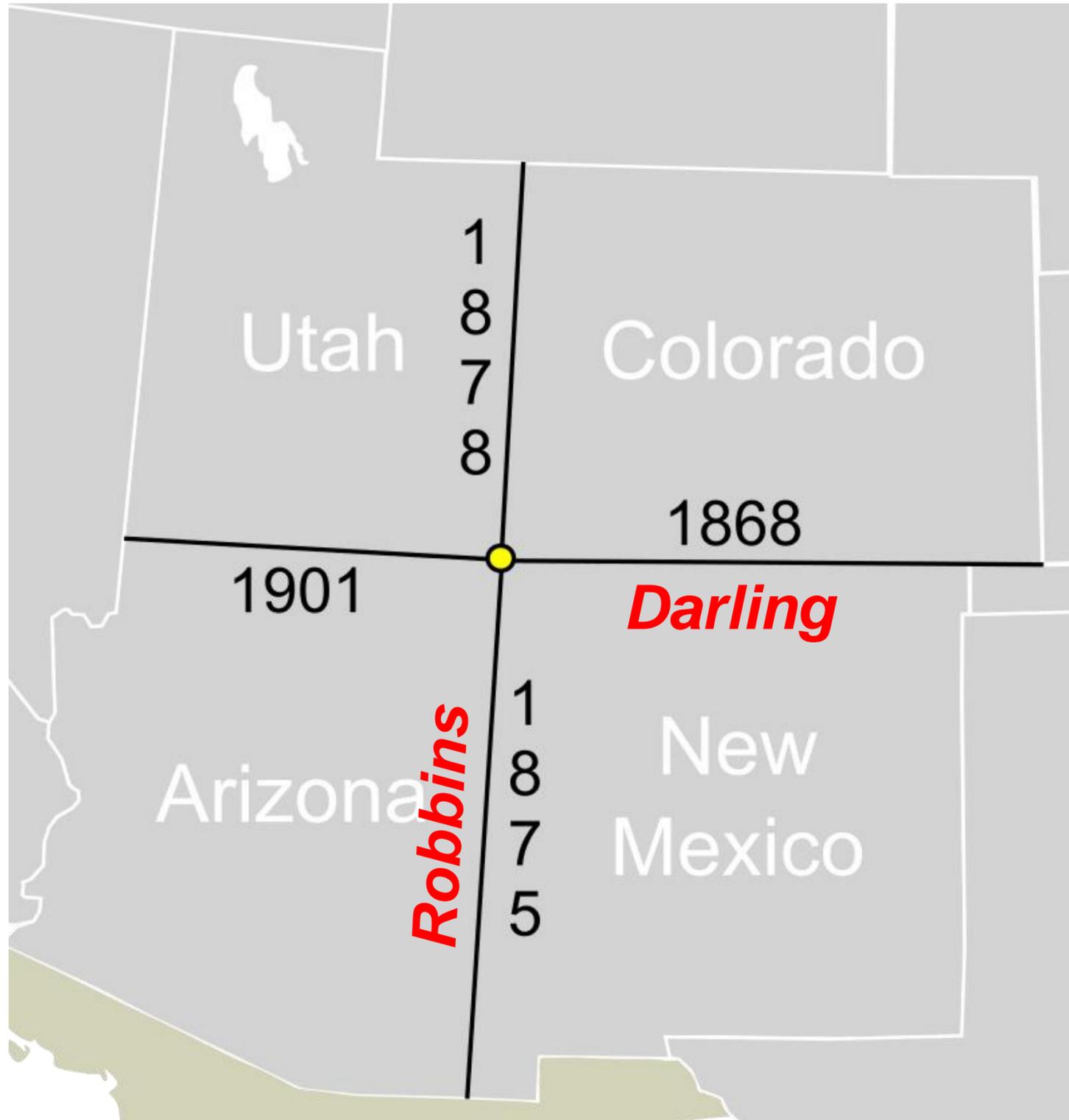
**Despite misinformed
commentary.**

There are 35 places where 3 states
meet on land,

But there's only one

Four Corners

Surveys at the Four Corners



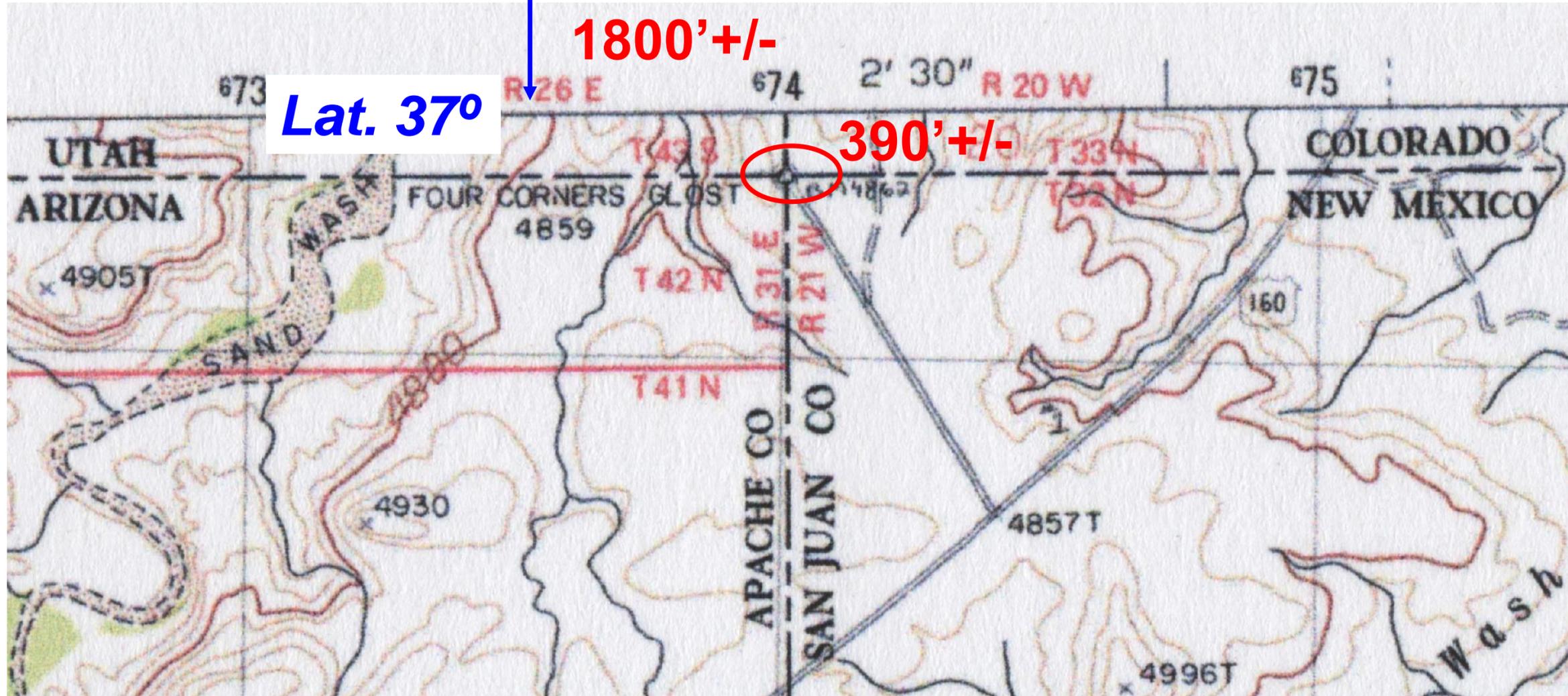
By Mangoman88 (talk) -
This file was derived
from: Blank US
Map.svg:author:
User:Thehibboleth, CC
BY-SA 3.0,
<https://commons.wikimedia.org/w/index.php?curid=26551239>

Long. 109°02'59.25"

1800'+/-

Lat. 37°

390'+/-



Tech Nos Pos Quad, 1982

***Media Reports Frequently Say
The Four-Corners Monument Is Wrong***
Purportedly out of position by 1800 feet;
or perhaps it's 2 ½ miles too far west;
Supposedly intended to be at
109 degrees West longitude

BUT

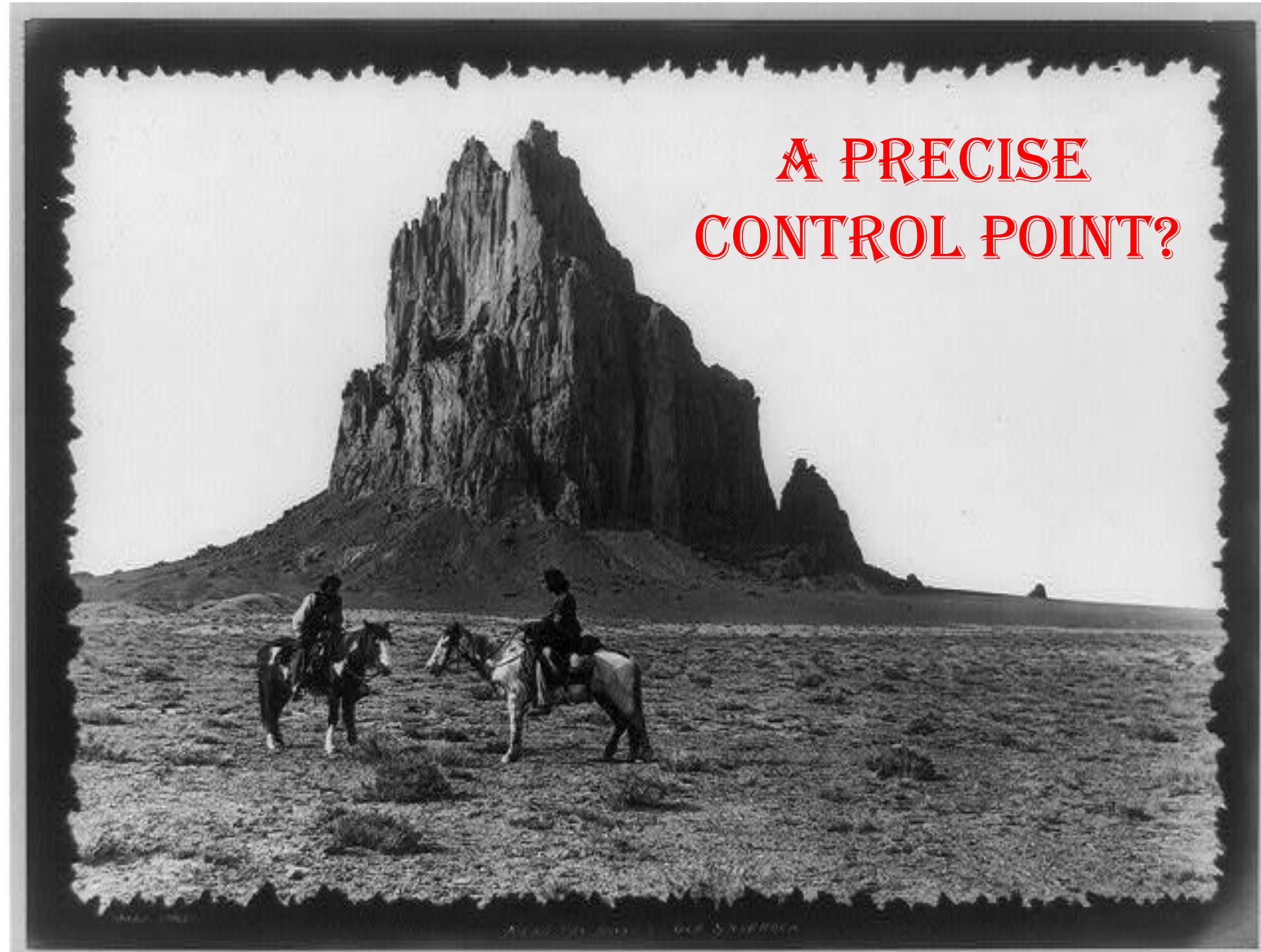
“technical geodetic details are absolutely moot when considering any question of the correctness or validity of the Four Corners monument in marking the intersection of the four states.”
(William Stone, NOAA, 2009, *Why the Four Corners Monument is in Exactly the Right Place*, green text in following slides is based on or quoting Stone)

Chandler Robbins Survey, 1875

Contracted by GLO to survey
Arizona-New Mexico boundary,
With control from coordinates of Ship Rock
determined by George Wheeler surveys

The 1863 law specified the AZ-NM boundary
as 32 degrees of longitude west of the
Washington, DC meridian,
Which corresponds to
109 degrees 02 minutes 59.25 seconds
West of Greenwich,
Robbins ran a South to North meridian line
from the Mexico boundary to intersect
Darling's "37th parallel".

1914 view of Ship Rock, from Library of Congress



Rising 1580' from the plain, 25 miles +/-
SE of Four Corners

How Did Wheeler Get the Coordinates?

They developed a triangulation network using mountain peaks and towns as vertices; Used a compass and theodolite to measure angles between a north line and the points, calculated the distances between peaks with trigonometry. Between 1872 and 1874, astronomers established observation sites at nineteen towns throughout Montana, Wyoming, Nebraska, Colorado, New Mexico, Utah, and Nevada, and used stone monuments as primary vertices of the triangulation network.

<https://www.usace.army.mil/About/History/Historical-Vignettes/Parks-and-Monuments/151-Wheeler-Science/>



In 1873, members of the Wheeler Survey erected an observatory just outside Ogden, Utah, which served as a central hub for the survey in determining latitudes and longitudes in the region. The center of the building housed a telescope, while the wings held equipment and workspace. This photo is by the survey's official photographer, Timothy O'Sullivan. National Archives

19 Control
Points In The
Outlined
Area,
Anchoring
The
Triangulation
Network



The Washington Meridian

used since 1850,

bisected the dome of old Naval Observatory

77 degrees 03 minutes West of Greenwich

“the boundaries of 11 western states are ...

Longitude-referenced to the Washington
Meridian, and not the Greenwich Meridian.”

The U.S. didn't adopt Greenwich until 1912

Longitude is a Measurement Based on Time

360 degrees ÷ 24 hours = 15 degrees per hour

John Harrison's chronometers and others that followed were a great advancement.

The breakthrough in connecting the US with Greenwich was the Transatlantic Cable, completed from Ireland to Nova Scotia in 1866, with a double check made available with a second cable in 1870 connecting Brest, France, to Duxbury, Massachusetts.

“In the construction of new charts for the use of navigators, as well as in the correction of old ones, the assignment of different latitudes and longitudes to the same point, by various authorities, has always been a source of difficulty and embarrassment. ...

The latitude of any point being determined directly by observation, and independently of the latitude of any other place, is less likely to be in error **than the longitude, which can only be ascertained with reference to the meridian of some other place; being measured by time,** is determined by the comparison of the local time with the time at some other place, the longitude of which is known.”

Telegraphic Determination of Longitude, by Francis Mathews Green

Lieutenant-Commander United States Navy

Popular Science Monthly, Vol. 7, August 1875

“Discrepancies in the results of observations for the determination of longitudes seem unavoidable with most of the methods usually employed, such as transportation of chronometers from place to place, observations of the relative positions of the moon and stars, and observations of occultations and eclipses.

Until the completion of telegraphic connection between this country and England, the exact longitude of the Washington Observatory was quite uncertain. A great many transfers of chronometers across the Atlantic had been effected by the Coast Survey at a great expenditure of labor and money. Yet the result of the latest expeditions differed from that deduced by Prof. Newcomb from moon-culminations by more than three and a half seconds of time, equal to nearly a mile, the final telegraphic determination lying between the two results.”

“As soon as the Atlantic cable was laid, in 1866, the Superintendent of the Coast Survey took advantage of the opportunity to establish, by way of Newfoundland and Ireland, the difference between the meridians of the British Islands and those of the United States.

In 1869-'70, a similar determination was made by different observers through the French cable from Duxbury, Massachusetts, to Brest. Again, in 1872, the measurement was made through the same cable, using the island of St. Pierre, in the Gulf of St. Lawrence, as an intermediate station.

The exquisite accuracy of the results of these measurements is demonstrated by their accordance.”

“Referring them to the station of the New York City Hall,
the resulting longitudes are as follows:”

1866	West of Greenwich	4h 56' 1.71”
1870		4h 56' 1.70”
1872		4h 56' 1.67”

According to NGS, at the 38th parallel of latitude one
second of longitude equals about 80 feet.

.04 times 80 = approx. 3.2 feet

“By means of these instruments, the error of the chronometer is found at each station with great accuracy, and, the times shown by the faces of the chronometers being compared by telegraph, the difference of time and corresponding difference of longitude are readily deduced.

The time occupied by an electric impulse to traverse the wire from one station to another, and act upon the telegraph-instruments, though generally very small, is too great to be neglected, but is easily ascertained and allowed for.”

“Some English astronomers have objected that, where the line is, as is usual in long land-lines, divided into lengths connected by telegraphic repeaters, the time of transmission will not be the same in both directions, and that the same effect would be produced in a submarine cable having an imperfection or leak nearer one end than the other. Experiments, however, by the Coast Survey on the long line from Washington to San Francisco indicate that this objection, though theoretically true, is of no practical importance.”

A transiting telescope is mounted in an exact north-south meridian line; precise local time is determined by observations of known stars crossing the meridian; using chronometer set to sidereal time (based on known “fixed” stars, instead of the sun), circuit broken every second; pen mark **(a)** made on paper on a rotating cylinder Using a break circuit key, the observer can make a mark **(b)** at the passage of a star over the telescope wire;



With a finely divided scale time can be determined to within $1/20$ of a second.

Precise corrections are made to the chronometers at both stations, so the difference in time and longitude can be accurately determined;

There is a very small delay in the signal traveling through the wire, but it is easily corrected for.



How Close Was Chandler Robbins?

**1800' +/- too far East
and in Darling's line**

“There is ... uncertainty in precisely quantifying the relationship between the intended and actual monument locations due to changes ... in some technical details of the geodetic systems utilized. The actual offset might in fact be considerably less than our estimate.” (Stone, NOAA)

How Close Was Robbins?

“considering the relatively primitive surveying technology of the day, the remote and difficult prevailing field conditions, and the uncertainty in the survey’s beginning coordinates for Ship Rock, Chandler Robbins’ survey was a resounding success.”

**“He ‘nailed’ the location ...
to the best of his ability, using the tools and
information available to him at the time.”**

But is it “Right”?

**“the monument marks the *exact* spot
where the four states meet.**

**A basic tenet of boundary surveying is that once a
monument has been established and accepted by
the parties involved**

**(... the four territories and the U.S. Congress),
the location of the physical monument is the
ultimate authority ... and the intended location of
the point becomes secondary information.”**

“In surveying, monuments rule!”

**THE CORNER BELONGS WHERE THE CORNER IS,
BECAUSE THE CORNER IS
WHERE THE CORNER IS!**

**GPS and precise geodetic surveying can't tell us
exactly where the 4 corners monument is
supposed to be, because it is exactly (though not
precisely) where it is supposed to be, right where
the *original* surveyor Chandler Robbins put it in
1875.**

And Here It Is



By Ken Lund from Las Vegas, Nevada, USA - The Much Maligned, But Legal and Official, Boundary of New Mexico, Colorado, Arizona, and Utah, Uploaded by Jacopo Werther, CC BY-SA 2.0, <https://commons.wikimedia.org/w/index.php?curid=25562534>



And Here It Is

Mladen Antonov/AFP via Getty Images

Possession Needs to be Actual

GEORGIA v. SOUTH CAROLINA

497 U.S. 376 (1990)

“... there is little evidence either of prescription by South Carolina or of actual or constructive notice to Georgia sufficient to imply acquiescence by Georgia. Except for the activity by the Corps of Engineers, the islands received scant attention from anyone except members of the Barnwell family. And, *apart from some rice planting, there is little evidence of activity on the islands other than illegal whiskey production and the raising of hogs fed with the mash.* The fact that moonshining could be carried on successfully shows how little attention was paid to the islands by Georgia authorities and the public generally. Except for the placement of a battery on the islands by Confederate forces during the War Between the States, there never was any resident on the islands and no schools, roads, or other public improvements.”

Sometimes You Can Fix It

272 U.S. 21, OK v. TX, (1926)

The line between Oklahoma and Texas was described as running North from the Red River along the 100th meridian of longitude.

OK and the U.S. claimed the boundary followed an 1859 survey made for the Commissioner of Indian Affairs by A.H. Jones and H.M.C. Brown, retraced and extended in 1860 by John H. Clark.

Texas claimed it followed a more easterly line running north from a monument set in 1902 by Arthur D. Kidder, at the “true” 100th meridian, which he then surveyed in 1903.

Putting it Where it Belongs

The Court cited MD v. WV, and NM v. CO, regarding recognition and acquiescence, but then added:

“We find, however, upon the facts, that the Jones, Brown and Clark line has not been established as the boundary line by any such long continued recognition and acquiescence.”

“On the entire case our conclusions therefore are: that neither the Jones, Brown and Clark line, nor a line running north from the Kidder monument has been established as the boundary line; that the boundary is the line of the true 100th meridian extending north from its intersection with the south bank of the South Fork of Red River to its intersection with the parallel of 36 degrees, 30 minutes; and that this line should now be accurately located and marked by a commissioner or commissioners appointed by the court, whose report shall be subject to its approval.”

Gannett's Survey

January 23, 1927, Samuel S. Gannett was appointed “to run, locate and mark the boundary between the two States as determined by this decree. In ascertaining and locating the line of said meridian the commissioner shall use the most accurate method now known to science and applicable in that locality; and he shall mark the boundary, as thus ascertained, by establishing permanent monuments thereon, suitably marked and at appropriate distances.”

Gannett's report was received July 15, 1929,
and a decree confirmed it on March 17, 1930.

SESSION EVALUATION

