

Volume 24: Issue 3
July, 2013



LINES & POINTS

www.plsw.org



THE EQUALITY STATE SURVEYOR
PROFESSIONAL LAND SURVEYORS OF WYOMING



HIXON
Mfg. & Supply Co.
www.hixonmfg.com

SALES - SERVICE - RENTAL

TWO CONVENIENT RETAIL LOCATIONS
SURVEY, CONSTRUCTION, AND ENGINEERING
INSTRUMENTS AND SUPPLIES

LARGEST GNSS RTK REFERENCE
NETWORK IN COLORADO AND WYOMING

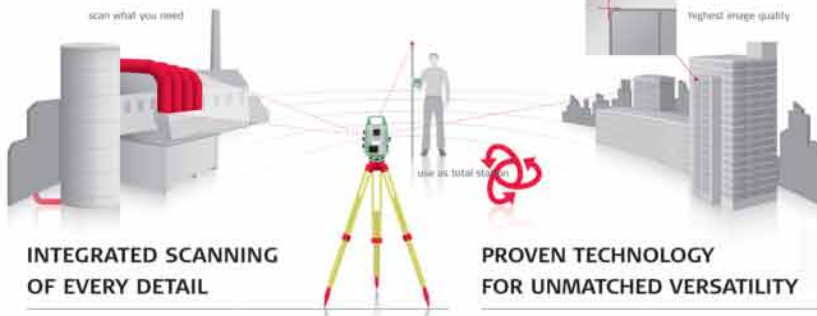
LOCAL SUPPORT, TRAINING, AND SERVICE

24/7 WEB STORE - www.hixonmfg.com

MS50 MultiStation – The **new** **dimension** in measuring technology

You only get a moment to make the right decision. So ultimate performance and absolute reliability are critical. This requires not only intuition, but also intelligent technology you can rely on. For the first time, the Leica Nova MS50 combines every significant measuring technology in one device and opens the doors to a fascinating new dimension of the geospatial world. All functions, including precision 3D scanning, extensive and precise total station capabilities, digital imagery and GNSS connectivity are now brought together in the Leica Nova MultiStation. A revolutionary solution with advanced measuring technology that provides unchallenged accuracy and quality, yet is easy to use for an unprecedented range of applications.

The capabilities of the Leica Nova MultiStation are truly comprehensive and second to none.



**INTEGRATED SCANNING
OF EVERY DETAIL**

The Leica Nova MS50 integrates 3D point cloud measurements into a regular survey workflow. This lets you collect and visualise your topographic survey data together with detailed high-precision scans. Save time by checking your data for integrity and relevance and avoid costly reworking or returns to the field. Benefit from better decisions with richer and more detailed data.

**PROVEN TECHNOLOGY
FOR UNMATCHED VERSATILITY**

The Leica Nova MS50 provides proven total station functionality with superior sensor integration for highest precision, performance and full automation of measurement procedures. Together with the benefits of GNSS connectivity, the Leica Nova MS50 offers complete versatility by delivering reliable results wherever and whenever you need them.



**IMAGE ASSISTANCE
FOR EVERY SITUATION**

The Leica Nova MS50 features an overview camera and a telescope camera with 30x magnification and autofocus. State-of-the-art image processing technology delivers live fluid video streaming of highest image quality. The imaging capabilities of the Leica Nova MS50 open up new opportunities of operating the MultiStation in an almost infinite range of applications.

Leica
Geosystems



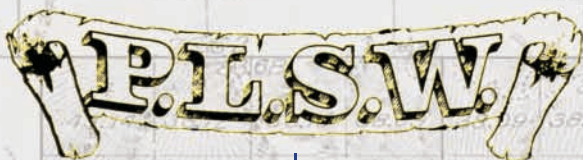
FORT COLLINS
1001 SMITHFIELD DR
FORT COLLINS, CO 80524
970.482.0111 800.762.5252

www.hixonmfg.com



DENVER
8775 E ORCHARD RD, #807
GREENWOOD VILLAGE, CO 80111
303.694.0012 800.475.3422





PRESIDENT • Cevin Imus, PLS

VICE-PRESIDENT • Carl Carmichael, PLS

SECRETARY/TREASURER • Marlowe Scherbel, PLS



• Cotton Jones, PLS
Area Governor



• Paul Reid, PLS
Wyoming Delegate

LINES & POINTS EDITORIAL COMMITTEE

Committee Chair • Larry Perry, PLS
arpentator@yahoo.com

Editor in Chief • Michael Flaim, PELS
mike.flaim@bresnan.net

Treasurer • John "Jack" Studley, PLS
jklz0318@gmail.com

Circulation • Joel Ebner, PLS
joel_ebner@blm.gov

Advertising • Pete Hutchison, PELS
peteh@bresnan.net

Copy Editor • Herbert W. Stoughton, PhD, PELS, CP
hws.geod.engr@bresnan.net

Editor at Large • Steven "Dennis" Dawson, PLS
denniemdbarb@aol.com



On The Cover

FIRMLY SET STONE WITH NOTCHES
(Photo by Tom Johnson)

CONTENTS

Page 3 • PRESIDENT'S MESSAGE

Page 4 • ANNOUNCEMENTS

Page 5 • AFTER 50 YEARS,
JOHN STEIL RETIRES
By: Ali Helgoth, Wyoming Tribune Eagle

Page 7 • RESPONSE TO PLSW SE CHAPTER'S
LETTER TO NSPS

Page 11 • WILLIAM C. "BILL" HEATLEY
Obituary

Page 13 • "JUST GO UNTIL YOU LOSE SIGNAL"
By: Tom Johnson, PLS, CFedS

Page 20 • ANSWERS TO THE "YOU'VE USED THEM"
COUNTY COURTHOUSE GAME
By: Michael Flaim, PELS

Page 23 • GEODETIC SURVEYING: PART III
GROWING PAINS
By: Herbert W. Stoughton, PhD, PELS, CP

2012 PLSW SUSTAINING MEMBERS

- John Baffert - Surv-KAP, LLC
- Troy Langston - Monsen Engineering
- Richard Monsen - Monsen Engineering
- Bryan Baker - Frontier Precision Inc.
- Chris Farnsworth - RDO Integrated Controls

Advertising Information

Digital-ready, full-color advertising with payment should be mailed to Lines & Points, P.O. Box 8, Cheyenne, WY 82003.

Advertising rates are as follows:	Year	Issue
Full Page	\$810	\$210
Half Page	\$540	\$140
Quarter Page	\$310	\$80
Business Card	\$160	\$40
Employment	Free	Free

Special Rates apply for PLSW Chapters and cover placements.

For more information please contact Pete Hutchison or Jack Studley.

PLSW (Professional Land Surveyors of Wyoming) is a statewide organization of Land Surveyors registered to practice in the Equality State of Wyoming. PLSW is dedicated to improving the technical, legal, and business aspects of surveying in the State of Wyoming. PLSW is affiliated with the National Society of Professional Surveyors (NSPS) and the Western Federation of Professional Land Surveyors (WestFed).

Lines and Points is published by the Professional Land Surveyors of Wyoming. Lines and Points is not copyrighted and permission is hereby granted to reprint articles with appropriate credit. The Professional Land Surveyors of Wyoming assume no responsibility for statements made or opinions expressed in this publication. The articles and opinions as put forth in this journal are not necessarily those of PLSW or the Editorial staff of this journal.

PRESIDENT'S MESSAGE



Fellow PLSW Members,

In my last President's Message I looked forward to the work spring would hopefully provide each of us. However, now that summer is here I am struggling with just keeping my head above water. I hope this message finds each of you overwhelmed with work and enjoying the summer with family and friends.

One step necessary to complete the paperwork to become a 100% Membership in NSPS is creating a Memorandum of Understanding (MOU). As directed by the Board, Cotton Jones, Paul Reid, Jeff Jones and Rick Hudson have been working together to create a MOU that follows the requirements for the NSPS membership and has the necessary verbiage to provide the PLSW guidelines for many years to come. With the exception of California and Colorado the western states have either a signed MOU or are in the process of creating MOU.

At our last board meeting, it was decided to entertain sponsorship of the Fall Tech Social Hour on Thursday evening and the board elaborated further on the potential to have meals sponsored as well. Since the board meeting, I have confirmation that Frontier Precision has

agreed to sponsor up to \$500 to assist with the Social Hour. I would like to personally thank them for their generosity and encourage all PLSW members to thank them as well.

Currently the PLSW web page doesn't look any different than it did last fall; however, Mark Rehwaldt and Masson Hall (University of Wyoming Student), are working together to make the necessary changes with updates and annual maintenance. We realize the web site has not been that useful at times and we all have the desire to see that we get the project completed and maintained.

In closing, I want to once again thank the membership for their involvement. PLSW would not exist if it was not for all of you and I urge you to recruit a new member, don't be afraid to reach out to younger surveyors or new hires in your community. Mark your calendar, Fall Tech will be held in Casper November 7th and 8th at the Ramkota.

Respectfully,

Cevin C. Imus, P.L.S., President

Professional Land Surveyors of Wyoming

ANNOUNCEMENTS

The PLSW Scholarship Committee would like to announce that Luke Provart was recently awarded a \$500 scholarship. Luke has completed a B.S. in Engineering from the University of Wyoming and is continuing his education through the UW Outreach Program with the goal of obtaining his LSIT and eventually a PLS. Luke is currently employed as a Surveying Technician with GDA Engineers in Cody, Wyoming



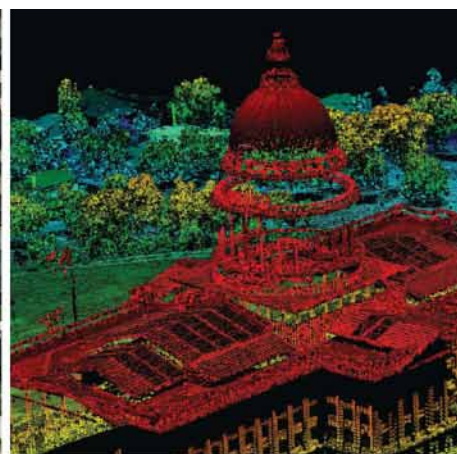
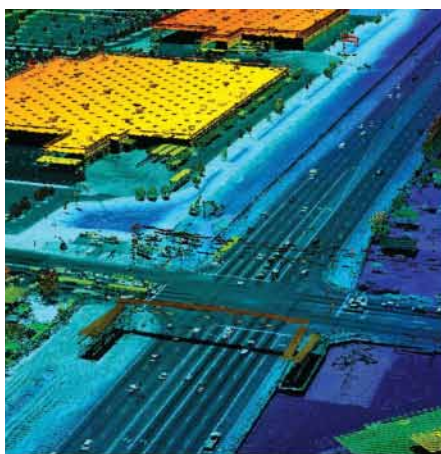
SURVEY SUPPLY SERVICE COMPANY

MANUFACTURER CUSTOM
SURVEY STAKES, LATH, & BRASS CAPS
FLAGGING - PIN FLAGS - FLUORESCENT PAINT
ROBERT C. SHOOK

P.O. Box 51227
Casper, WY 82605-1227
307-234-9856

LINES AND POINTS ARTICLE ROTATION SUBMISSION SCHEDULE BY CHAPTER

<u>Responsible Chapter</u>	<u>First Call Date</u>	<u>Last Call Date</u>	<u>Publication Date</u>
Central Chapter	THANK YOU!! (SEE "JUST GO UNTIL YOU LOSE SIGNAL" IN THIS ISSUE)		
South Central Chapter	September 1	September 15	October 1
Southeast Chapter	December 1	December 15, 2013	January 1, 2014
Laramie Valley Chapter	March 1	March 15	April 1
Upper Platte Chapter	June 1	June 15	July 1
Southwest Chapter	September 1	September 15	October 1
Northeast Chapter	December 1	December 15, 2014	January 1, 2015



■ Digital Aerial Photography ■ LIDAR

■ Topographic Mapping ■ Orthorectified Imagery



40 West Oakland Avenue, Salt Lake City, UT 84115 · PHONE: 801-487-3273 · FAX: 801-487-3313

AFTER 50 YEARS, JOHN STEIL RETIRES

By ALI HELGOTH

ahelgoth@wyomingnews.com



John Steil is retiring after 50 years in the surveying business.

SEVERAL DECADES OF PERFORMING THE WORLD'S "SECOND-OLDEST PROFESSION" WON'T END HIS WORK - IT'S ALSO A HOBBY

Michael Smith/WTE staff

Reprinted from the May 12, 2013 edition of the Wyoming Tribune-Eagle with permission of Cheyenne Newspapers, Inc., Copyright 2013. All rights reserved

CHEYENNE - After nearly 50 years as a surveyor, John Steil recently decided to retire.

But don't expect him to stop survey work just because it's no longer his job. For Steil, it's also a hobby.

Survey work is a noble profession, he said. And working in the field meant doing the work of the world's "second-oldest profession."

People have always needed to know where property lines were, he explained.

He remembers years ago doing survey work for the U.S. Forest Service in South Dakota.

Every day he could see Mount Rushmore as he worked, the faces of three of the country's most famous surveyors - George Washington, Thomas Jefferson and Abraham Lincoln - and one other guy, he joked, watching over his shoulder.

"It's amazing how many beautiful areas you find when you're out surveying that normal people don't see," he said.

While some his work was in remote places, much was in Laramie County, where he would do survey work for sites that would soon become very visible.

He came to Cheyenne in 1977 when the company he was working for, Minnesota-based BRW, was contracted to build a dome for the University of Wyoming's football stadium. Although that project never happened, when BRW closed its Cheyenne branch, Steil stayed. In 1982, he opened Steil Surveying Services.

His company worked on most commercial and residential developments in Cheyenne and the surrounding area, he said.

The business he started is now in the hands of his son, Brad, and longtime employee Jeff Jones.

"I've been with John since 1993, and I guess what he taught me and I've admired most about him is his dedication to the profession and his dedication to the community," Jones said.

He said Steil was always willing to donate to local organizations, be it Cheyenne Frontier Days, the Cheyenne Boys & Girls Club or youth baseball.

Gene MacDonald of Ayers Associates said the business is in capable hands, but Steil's retirement is a loss. He called him "one of the most knowledgeable surveyors to work in this community."

Jack Studley, surveyor for the city of Cheyenne, said "from the '70s through the present, John has had a significant impact on the surveying aspect of the entire city of Cheyenne and Laramie County."

But it's not just his surveying work that has shaped Cheyenne.

Steil has served on the board of the Greater Cheyenne Chamber

of Commerce, Cheyenne LEADS, Laramie County Community College Advisory Board and the Cheyenne-Laramie County Economic Development Joint Powers Board.

"There's not a better feeling than when you find an original corner set 140 years ago."

John Steil
Retiring surveyor

He also volunteered for Cheyenne Frontier Days and served as chairman of the Contestants Committee from 1998 to 2000.

"He brought a whole lot to the table as far as general business," said Jim Johnson, who served as general chairman while Steil volunteered. "He's just a wonderful guy."

While Steil doesn't yet have specific plans for retirement, he

said he will travel - and do some survey work along the way.

This summer, he will participate in a Surveyors Rendezvous in Philadelphia. They plan to find the southernmost point of the city, where Mason and Dixon began their survey.

Other historic projects he has worked on include helping to locate the four original city corners, finding markers throughout the state, surveying the Mason-Dixon line and locating the initial point set for the 6th principal meridian south of Lincoln, Neb.

"There's not a better feeling than when you find an original corner set 140 years ago," he said.

That's another way he hopes to give back to the community and his profession.

"Hopefully 150 years from now people will be finding my corners," he said.

We, the Professional Land Surveyors of Wyoming, hereby agree to the terms stipulated for the reprinting in our quarterly newsletter of Ali Helgoth's story on the retirement of John Steil, which was published in the May 12, 2013, edition of the Wyoming Tribune Eagle.

L&P Editor's Note:

John Steil is a charter member of the Professional Land Surveyors of Wyoming (PLSW) and the organization's second elected President. John served many years as the Chairman of the PLSW Legislative Committee. John was an original member of Surveyors of the Sixth Principal Meridian and an active participant in the National Society of Professional Surveyors (NSPS) and the Western Federation of Professional Surveyors (WestFed).



GIS
IN THE ROCKIES
2013 LOCAL TO GLOBAL:
GEOSPATIAL ON THE MOVE

GIS in the Rockies Conference October 9-10, 2013

EARLY REGISTRATION IS \$250 (SAVE \$75) AVAILABLE THROUGH JUNE 30



SCHERBEL ON SURVEYING

A compilation of parts of the
WYOMING STATUTES
and others items of interest to
PROFESSIONAL LAND SURVEYORS
Order from SURVEYOR SCHERBEL, LTD.
Box 96, Big Piney - Marbleton, Wyoming 83113
\$60.00 postpaid

Prior to responding to the questions in the letter from PLSW dated January 10 , 2013, it is important to note the following in order to provide context for the answers:

**ACA is mentioned several times in the questions. ACA was renamed CaGIS many years prior to the filing of its intention to separate from ACSM in January 2009. After the mandatory two-year waiting period, CaGIS ceased to be a MO of ACSM in January 2011. Therefore, hereinafter, any reference to the organization formerly known as ACA will be stated as CaGIS. With its departure from ACSM, CaGIS took with it all rights to, and responsibilities for, the CaGIS journal.*

**Unnamed in any of the questions to which answers are hereby provided is the organization known as GLIS. GLIS became a MO of ACSM in the late 1980's, and like the other three (at the time) MOs, it became an independently incorporated entity when ACSM was restructured in 2004.*

**After 2004, all ACSM MOs were independently incorporated entities which together formed ACSM. From that point forward until the 2012 merger of ACSM into NSPS, ACSM served as an administrative body performing services for the respective MOs, and coordinating the activities they chose to engage in collectively*

Professional Land Surveyors
of Wyoming

Attn.: Mr. Marlowe Scherbel,
Secretary/Treasurer
P.O. Box 725
Afton, Wyoming 8311 0

Dear Marlowe:

At the last meeting of the Southeast Chapter, the matter of joint dues and affiliation of PLSW with the National Society of Professional Surveyors was discussed briefly. A number of questions were raised, and no answers were available. The attending members requested that I submit a list of concerns which have not been addressed (in writing and in detail). These are:

1. How were the assets (financial and physical) of the parent organization ACSM divided and dispersed to the three remaining Member Organizations (M.O.'s)- AAGS, ACA, and NSPS?

Neither the assets, nor the liabilities, of ACSM were divided and dispersed to the three remaining MOs at the time of merger. As the surviving entity in the merger, NSPS took possession of all ACSM assets and liabilities. This was agreed upon by the MOs as part of the agreement for the merger to take place.

2. In ACSM, the official publications

were The Bulletin, SAGLIS, and CAGIS. The latter publication was the sole responsibility of ACA, which means that the publication would be assigned to ACA. The publication SAGLIS was the shared responsibility of AAGS and NSPS. Which organization (AAGS, NSPS) will have future responsibility, or will the responsibility be shared? If the responsibility will be shared, what is the formal arrangement? The Bulletin was the official (for purpose of announcements and business) publication of all three M.O.'S. What is the resolution of the responsibility for this publication?

Regarding the CaGIS journal, see paragraph 2 of the opening statement herein.

After the restructure of ACSM in 2004, The Bulletin magazine remained the property of ACSM, and served as a member benefit to all MOs. With the merger of ACSM into NSPS in 2012, The Bulletin became the property of NSPS with NSPS taking on the responsibility for it.

The name of the publication referred to as SAGLIS in Question 2 is actually SaLIS. It is a peer-reviewed journal which has been jointly owned by AAGS, GLIS, and NSPS since the 2004 restructure of ACSM. The three (3) MOs agreed in the NSPS/ACSM merger document that they would

collectively own SaLIS, each being an equal partner, sharing both the assets and liabilities of the publication equally. A MOU was created to document this agreement.

3. There are a number of professional land surveyors throughout the United States who have been members of ACSM, but their technical affiliation (M.O.) has been with either AAGS or ACA and not NSPS. If these individuals wish to retain their AAGS and/or ACA affiliations, how does this new "dues" arrangement affect them? Will there be a clarification for the dues for those members who are affiliated with the other M.O.'s?

Membership in any of the former ACSM MOs is at the discretion of the individual member. Any dues owed as a result of such elective membership in any of the organizations is directly payable to that organization. NSPS has no "additional member" arrangements with either AAG or GLIS through which some reduced rate for membership in one or the other of such organizations would be allowed. NSPS is not aware of whether or not AAGS and GLIS have such arrangements.

Dues renewal notices from NSPS do not accommodate payment of any dues owed to other organizations. Again, NSPS cannot speak for

AAGS nor GLIS about any such accommodations they may have for the members of the other.

4. Will the PLSW membership (as individuals) have any input in the educational, financial, philosophical, professional, and technical matters of NSPS? If the answer is affirmative, what is the forum available to them?

As has been the case with NSPS in the past, and is the case with most member organizations, individual members are encouraged to participate in any and all activities undertaken by the organization. All members are encouraged to participate on committees, run for elective offices, act as a liaison with the public through the TrigStar and CST programs, the Hydrographer Certification program, the Boy Scout Merit Badge program, as a member of the NSPS Program Evaluator (PEV) team for ABET accreditation of surveying and geomatics college programs, and many other NSPS activities.

The forum for such participation is simply to express an interest and commit to actively engage.

Additionally, a member may wish to serve on the NSPS Board of Governors or Board of Directors. NSPS Governors are elected / appointed by the respective state societies. Directors are currently elected by NSPS members who are residents of the states that are located in one of 10 designated geographic "Areas".

With the progression of the 100% joint state/national membership program, it is possible that the governance structure could change since each state society that has enrolled in the program will have a seat on the NSPS Board of Directors. Under the current governance structure this would mean that those

state societies would have a seat on the advisory Board of Governors and a seat on the NSPS Board of Directors, the final decision making body. At some point in time, it may be determined that only one body is necessary, but that is a ways down the road.

5. If a member of PLSW, who is not a professional land surveyor (in Wyoming) but holds "full voting membership" in one of the other M.O.'s, what will be the individual's membership status (and voting rights) in NSPS?

Membership in any other former ACSM Member Organization (MO) provides no voting rights in NSPS. Only NSPS members are provided voting rights. NSPS does offer full membership, thus voting rights, to some who are not licensed professionals land surveyors. The criteria for such membership is spelled out on the NSPS membership application.

6. There are numerous "societal affiliations" that ACSM had [F.I.G., ABET, ASCE, ASPRS, ICA, etc]. Most of these affiliations are interlocked with the former organization the American Congress on Surveying and Mapping. How have these affiliations been "transferred"? Although it has not been specifically explained, it would appear that NSPS plans to "adopt" these affiliations, and that any interactions with AAGS and ACA have been ignored.

NSPS has taken on the societal affiliations with other organizations that were formerly ACSM affiliations. For example, NSPS is now a Member Society of ABET where it is recognized as the Lead Society for the evaluation of surveying and geomatics programs under the EAC, ASAC, and ETAC criteria. Likewise, NSPS is now

recognized as the U.S. member of FIG. For quite some time (pre-merger) NSPS has held a seat on the Participating Organizations Liaison Council (POLC) in NCEES. For many years, NSPS has been the effective member of the ALTA/ACSM joint committee with ALTA. There are surely other such relationships not mentioned here that are similarly situated.

This does not mean that the other former ACSM MOs have been ignored. In fact, the MOU between AAGS and NSPS stipulates that AAGS members are to be participants with NSPS in ABET and FIG. AAGS reimburses NSPS for a small portion of dues paid to these organizations. It is critical that AAGS members remain actively engaged in the activities of these organizations through its relationship with NSPS.

GLIS was offered similar participation, but did not accept the offer.

CaGIS (formerly ACA) had very little participation in any of these activities prior to its separation from ACSM, and has had none since departing from ACSM.

NSPS continues to interact with other professional organizations, in particular through its membership in the Coalition of Geospatial Organizations (COGO) which includes member organizations representing virtually every aspect of the geospatial community. NSPS also continues its relationships with other professional organizations through its membership in the Council on Federal Procurement of Architectural and Engineering Services (COFPAES). This watchdog group monitors compliance with the federal professional services contracting law commonly known as the Brooks Act which stipulates the

use of Qualifications Based Selection (QBS) procurement of A/E services, including surveying and mapping.

NSPS continues the efforts of our national organization in participating with federal agencies and committees that are related to professional surveying practice, and any activity that affects such practice.

7. There are a number of ACSM Honor Members, ACSM Fellows, and ACSM Life Members. Does NSPS plan to honor and respect these honoraries as originally awarded with respect to dues and voting rights?

With the reorganization of ACSM in 2004, each of the ACSM MOs recognized that it could no longer continue to provide full benefits to honorary members free of charge.

Through the restructure, each MO took responsibility for Life and Fellow members who were within their respective membership. Henceforth from the date of restructure, those who would be named as Fellows by one of the MOs were also considered ACSM Fellows.

Each MO set up its own guidelines regarding how it would accommodate Life and Fellow members.

NSPS Fellows were never offered dues reductions. In fact, NSPS Fellows pay extra dues (\$10/year) as a contribution to the NSPS Foundation scholarship fund.

Considering that NSPS Fellow membership is not offered to non-members, voting rights for Fellows remain the same as before, as do voting rights for NSPS Life members who choose to pay the reduced membership fee.

8. Has the new NSPS negotiated and written cooperative agreements with AAGS and ACA concerning areas of common interest? These

agreements should be available for review.

As mentioned previously herein, AAGS and NSPS have a Memorandum of Understanding (MOU). If not already posted on the AAGS or NSPS website, it can be requested for review.

There is no such document between NSPS and either GLIS or CaGIS (formerly ACA).

9. Historically, there have been the Annual ACSM and Fall ACSM meetings providing technical and educational sessions. In recent years, these meetings have been affiliated with a regional or multi-state meeting. What are the future plans for these arrangements? Are there any plans to work with AAGS and ACA in planning and organizing these sessions? Is there a written agreement for such an arrangement?

Through the summer of 2012, ACSM continued to hold conferences, sometimes in partnership with state, regional, or national organizations. The fall off in attendance, and in participation by vendors, at such meetings led to a decision that no conference would be held in 2012.

A group of leaders made up of members of NSPS, AAGS, and other national organizations, along with the vendor community, and agency representatives has been working to reinvent a national conference that would be attractive to both attendees and exhibitors. It is likely to take a couple of years of research and planning in order to offer such a conference.

NSPS also continues to be in contact with state societies and regional groups in search of opportunities for collaboration for conferencing. No formal agreements have been signed.

10. In PLSW, and probably other state professional societies, there are a number of individual members who have been granted a membership status which does not require payment of dues (honorary members, life members, retired members, etc.), but have full voting rights, how does the proposed PLSW - NSPS affiliation plan to address this matter with respect to NSPS voting rights?

Any dues individuals pay to state professional societies does not affect NSPS dues.

Membership in NSPS is available to all members of state societies at the dues rate of \$40/year, regardless of whether they are voting members of the state society or not. The state society can determine which of its members to which it wishes to offer participation in the state/national joint membership program with NSPS.

Voting rights in NSPS are tied to one's membership in NSPS. If one meets the NSPS criteria to be a voting member, voting privileges will be granted.

11. Where can an individual find official documentation pertaining to all the technical, administrative, and legal actions which are taking place in this reorganization. Where are the meeting notes, white papers, etc. which document the discussions pertaining to the reorganizations? What is the status of all the matters raised in this letter?

All such documents are in the possession of NSPS. They are available for review upon request and approval of NSPS leadership. Some are posted on the NSPS website, www.nsps.us.com.

The question regarding the status of all the matters raised in the letter from PLSW is quite open-ended. If the letter is intended to ask the status

of the merger of ACSM into NSPS, that action was completed in 2012.

12. Where are the approved "charter", organization bylaws, and revised incorporation documents for inspection?

As noted above, all such documents are in the possession of NSPS.

13. When were there general membership votes by all the old ACSM membership to reorganize to the "new NSPS" and other M.O.'s? Was this course of action a unilateral action by NSPS?

As a result of the 2004 reorganization of ACSM, and the subsequent departure of CaGIS, at the time of the merger of ACSM into NSPS there were only three (3) members (known as the Member Organizations/MOs) of ACSM, those being as independently incorporated entities, AAGS, GLIS, and NSPS.

All individual members were members of the respective MOs.

Only the three corporate MOs were required to vote on the merger, but each consulted with its membership in a variety of ways prior to voting. The vote took place in early 2012.

The merger was certainly not a unilateral action by NSPS. An attempt was made to include all three of the then-MOs. However, neither AAGS nor GLIS chose to join in the merger.

As a wake-up call to action in April 2010, NSPS filed a letter of intent to withdraw as a MO of ACSM, similar to such action taken by CaGIS in 2009. Had NSPS intended to take unilateral action, it could have simply let the two-year withdrawal period take place, and it would have been separated from ACSM, leaving the responsibility for the assets and liabilities for

AAGS and GLIS to deal with. Considering that AAGS and GLIS at the time comprised roughly 5% of the collective membership of the ACSM MOs, this would have been an impossible undertaking.

It is important to be aware that under the structure of ACSM prior to the merger, NSPS was paying approximately 95% of ACSM expenses. Examples include: (dues, travel, etc.) associated with

membership in, or participation in the activities of, other organizations (such as ABET, FIG, etc.); expenses associated with the production and delivery of ACSM publications; staff and operational expenses.

The final agreement to the merger of ACSM into NSPS among the MOs was accomplished because each group wanted a result that did not reflect poorly on the reputation and history of ACSM.

40 YEARS & COUNTING



**Building relationships
one monument at a time.**

Berntsen

MARKING THE INFRASTRUCTURE OF THE WORLD

1.877.265.2290 • WWW.BERNTSEN.COM

William C. 'Bill' Heatley



Mr. Heatley died Thursday morning, February 14, 2013, at his home in Riverton. He was 70.

William Colin Heatley was born on August 24, 1942, in New Iberia, Louisiana, the son of William L. Heatley and Florine (Huff) Heatley.

He graduated from Natrona County High School in Casper in 1960. Following high school, he worked at several jobs in the oil field and in construction and graduated from Casper College in 1965. He attended the University of Wyoming and graduated in 1967 with a Bachelor of Science degree in Mechanical Engineering.

On June 5, 1964, he married Elizabeth J. "Betsy" Willison in Jackson, a marriage lasting 44 years until his beloved wife passed away in 2009.

Mr. Heatley lived in Riverton for 41 years. Born in New Iberia, Louisiana, he lived in 23 different residences with his family before he reached age 15 as his father worked in the oil fields of South Louisiana and the Rocky Mountains. Since 1967, he had also lived in the Colorado cities of Denver, Morrison, Westminster, and Leadville.

Following his college schooling, he worked as a Gas Engineer for Public Service Company of Colorado in Denver and Leadville. Upon returning to Wyoming, he settled in Riverton in 1972 where he worked for Northern Utilities as a District Engineer. In 1976, he went into the surveying field, starting as a rodman for Inberg Surveying Company. In 1981, while employed as a Mining Engineer for Federal-American Partners, he obtained his license as a Professional Land Surveyor in Wyoming and also in Nevada. At the shutdown of FAP mining operations in the Gas Hills, Mr. Heatley founded Apex Surveying in Riverton. In 1986, he sold his share of Apex Surveying and went to work as a Field Adjudication Inspector for the State of Wyoming.

In 1974, Mr. Heatley joined the Riverton Volunteer Fire Department. Over the next twenty years, he served in several offices in the department including Assistant Fire Chief. Several years after his retirement as an active fireman in 1995, he was elected as a Commissioner of the Riverton Fire Protection District where he served for 13 years.

In his younger years, he enjoyed hunting, competitive shooting sports, rock climbing and mountaineering. In his retirement years, his family said he enjoyed his dogs, reading history, and computer science. His family said he was

a strong believer of family, friends, and fidelity.

Survivors include a son, Robert David Heatley and his wife Donna Heatley of Riverton; a daughter, Rebecca Jo Murray of Riverton; six grandchildren in Riverton and Ten Sleep; and his sister, Alita Ann (Heatley) Thorpe of Norwich, England, United Kingdom.

He was preceded in death by his wife, Elizabeth J. "Betsy" Heatley; an infant son, William Albert Heatley; his father, William L. Heatley; his mother, Florine (Huff) Heatley; his grandparents, William David Heatley and wife Susan Anne (Colvin) Heatley and Robert Young Huff and wife Melanie Mae (Sureau) Huff.

Memorials may be made to Paws for Life, in care of the Davis Funeral Home, 2203 West Main, Riverton WY 82501.

On-line obituaries are available and condolences for the family may be made at: thedavisfuneralhome.com

PLSW FIELD BOOKS AVAILABLE

Embossed with the PLSW logo on the cover
Only \$10.00 each
 Available in Orange or Yellow



PLSW, SE Chapter % Larry T. Perry L.S.
 1127 Terry Ranch Road
 CHEYENNE, WYOMING 82007

SURVEYORS RENDEZVOUS 2013

*Historic Philadelphia
Stargazers Stone
South Street - Southernmost Point
Memorial Stone for Charles Mason*

August 28-31, 2013

Hyatt Regency Penn's Landing
Philadelphia PA 19106

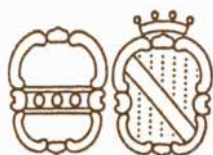


www.SurveyorsRendezvous.org

SPONSORED BY:



Surveyors
Historical
Society



Mason - Dixon
Line Preservation
Partnership



Pennsylvania
Society of Land
Surveyors



District of Columbia
Association of
Land Surveyors



Maryland
Society of
Surveyors



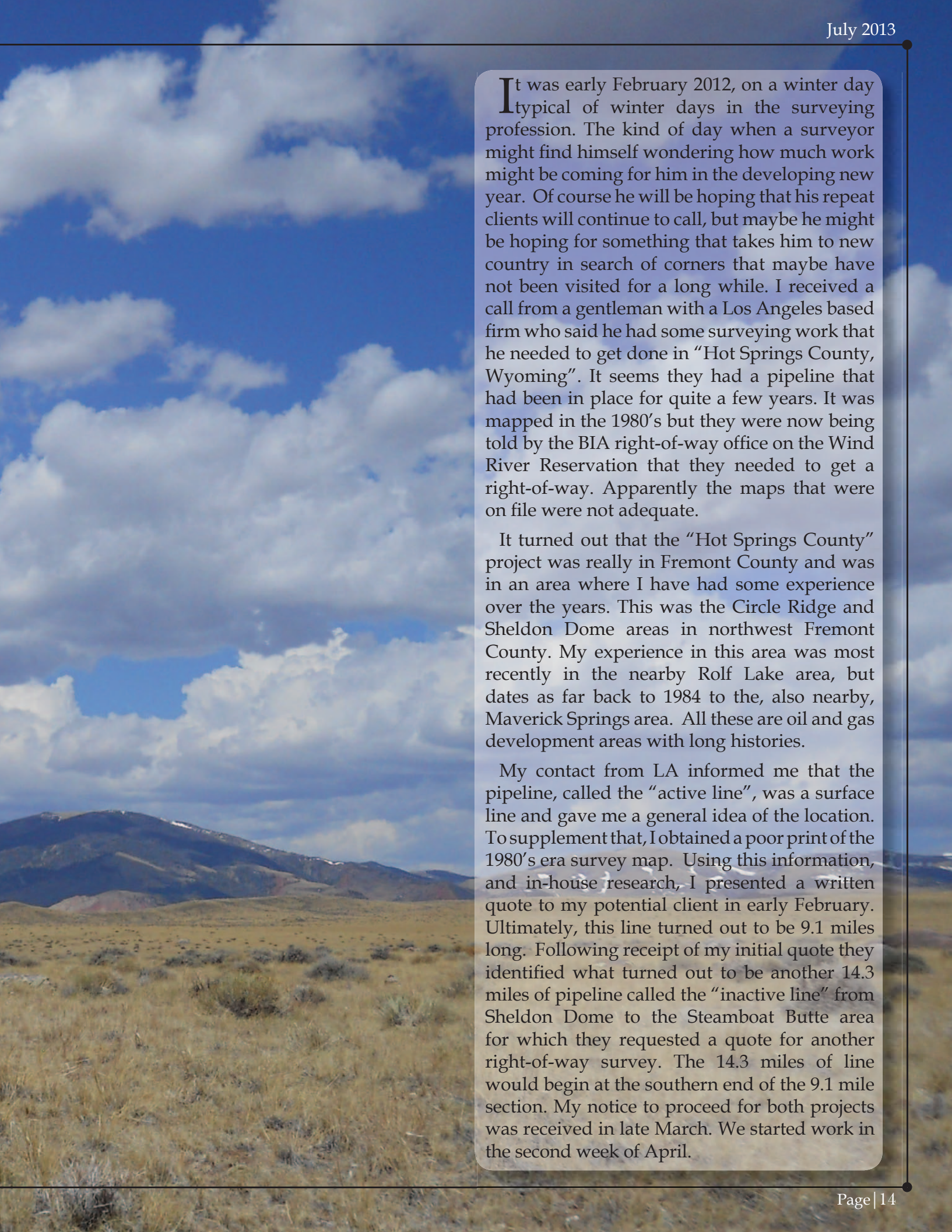
New Jersey Society
of Professional
Land Surveyors

“JUST GO UNTIL YOU LOSE SIGNAL”

By Tom Johnson, PLS, CFedS



A beautiful spring day surveying across a nice grassy ridge at 7000 ft. Elev.
(Black Mountain in the background)



It was early February 2012, on a winter day typical of winter days in the surveying profession. The kind of day when a surveyor might find himself wondering how much work might be coming for him in the developing new year. Of course he will be hoping that his repeat clients will continue to call, but maybe he might be hoping for something that takes him to new country in search of corners that maybe have not been visited for a long while. I received a call from a gentleman with a Los Angeles based firm who said he had some surveying work that he needed to get done in "Hot Springs County, Wyoming". It seems they had a pipeline that had been in place for quite a few years. It was mapped in the 1980's but they were now being told by the BIA right-of-way office on the Wind River Reservation that they needed to get a right-of-way. Apparently the maps that were on file were not adequate.

It turned out that the "Hot Springs County" project was really in Fremont County and was in an area where I have had some experience over the years. This was the Circle Ridge and Sheldon Dome areas in northwest Fremont County. My experience in this area was most recently in the nearby Rolf Lake area, but dates as far back to 1984 to the, also nearby, Maverick Springs area. All these are oil and gas development areas with long histories.

My contact from LA informed me that the pipeline, called the "active line", was a surface line and gave me a general idea of the location. To supplement that, I obtained a poor print of the 1980's era survey map. Using this information, and in-house research, I presented a written quote to my potential client in early February. Ultimately, this line turned out to be 9.1 miles long. Following receipt of my initial quote they identified what turned out to be another 14.3 miles of pipeline called the "inactive line" from Sheldon Dome to the Steamboat Butte area for which they requested a quote for another right-of-way survey. The 14.3 miles of line would begin at the southern end of the 9.1 mile section. My notice to proceed for both projects was received in late March. We started work in the second week of April.

In order to work on the WRIR (Wind River Indian Reservation) it was necessary to obtain a TERO (Tribal Employment Rights Office) contract and to obtain formal, written permission to survey from the JBC (Joint Business Council). While CFedS certification is another concern when working on the WRIR, there has been an on-again, off-again policy towards what type of work requires a CFedS. At the time of this project I believe it was not required for right-of-ways, but I was not concerned with that matter as I received my CFedS certification in 2010.

This is not a tale of heroic corner search, nor shiny new monumentation, but one of tackling a project with a joy of being out in the field, with a certain amount of tenacity toward getting control set, corners found, evidence located, making a productive plan that works with the correct organizational entities, prepare the map, and last but not least, satisfy the client.

My approach to the survey was to use ATV's for access as the pipeline was not along any roads. There was a faint trail along much of the line apparently used during periods of pipeline inspection. I used a two man crew. My partner for the project would be Dave Meserve. Dave has been employed with Apex for a number of years

and came to us with years of field work experience from the Gillette area BLM. Dave would have the task of using one GPS rover to follow the pipeline on an ATV and tie it down. I retained the task of setting control to move our base around as needed to maintain radio contact, and, for the most part, I would be the one locating the land corners to tie the right-of-way to.

Our equipment was my trusty Dodge pickup with a couple of newer model Honda ATV's on a trailer. We blended the new and the old with our GPS survey equipment. I have been using a Viva model Leica GPS system for almost two years, and we would use a trustworthy, though aged, Leica 530 series rover setup for our second rover. The contrast in the RTK range of these instruments became apparent in the days to come.

For control for this work, we used and expanded upon a control system established by Gary Hatle of Apex Surveying in 2003, when he staked some well locations in the Sheldon Dome area. His local control was mostly in about a 4 square mile area, but when he established the system he had occupied NGS control points in a much larger area. Therefore, I decided that his control was adequate to expand for the purposes of my survey. The active line survey was going to have to cover 9+





Firmly set stone with notches

miles northwesterly from the established control, and I knew by the time we began the active line survey that I was also going to need control for an additional 14+ miles southeasterly. Therefore, at the beginning of the field work I was determined to establish all of the control I would need for both projects.

While the active line survey was to be 9.1 miles in length, the existing road system made the journey from the south end of the job, where we kicked off, to the north end, a trip of roughly 20 miles. Much of it being over rough dirt roads. The inactive line survey would kick off where the active line ended and we would work it from northerly to southeasterly. The road system to access the inactive survey would be a trip of roughly 18 miles, some of it paved but in poor shape. While I had a corridor of roughly 23 miles that I would have to cover with RTK suitable control, I was able to conduct both surveys from 7 reference setups, with some other control points established

either as intermediate control or “just in case we need them”. We occupied two of Gary’s original control points, GLH2 and GLH3, and from them I established what I called APEX1 through APEX5. On the final day of field survey, I chose to set up on a section corner, as a control point, from which I would carefully search the final group of sections for corners.

The first day of surveying the surface pipeline was pretty disappointing. Dave lost RTK at a point which was only 2.6 miles up the line, and only 2 miles from the control we had the base on. I had projected that we would get much further up the line on this day. So Dave was unable to proceed further by mid-day. I was out in the truck establishing control, so Dave occupied his time as best he could until we met up later in the afternoon. Clearly, the terrain in this area was going to be difficult. This was still in pretty open country. Some of the ridges were 300+ high but our base was up high. I knew that on the next day

out we would have to tackle a narrow canyon. This canyon was oriented just a little east of due south to north when approached from the south end. About one mile of our surface line ran through the bottom of it (rising from 6600-6700 feet in elevation) before climbing up and across the top of a wide bench (7050 feet in elevation) before dropping down again and crossing a flat towards the south toe of the outside of Circle Ridge. I had thought it was going to be "iffy" to get reception in there, but given the limited range on day one, I was more concerned.

We were not going to get the base any higher in elevation and still be able to access our setup with a truck. We scouted a location for another control point where we had good vehicle access, and which would give a better line of sight northeasterly into the canyon. Hopefully, this would help make day two more productive and we could conclude the south end of the job in anticipation of setting up our base on the north end of the job for day 3.

Bright and early on field day 2, we arrived at the new control point "APEX5". I determined that to make sure that we got this south end surveyed I would help Dave with shooting pipeline. We both mounted our ATV's with our rovers with the plan being that I would go to the point where Dave left off on the last field day, and Dave would travel north up into the canyon until he could no longer get radio link to the base. At that point he would turn and start shooting the line back towards me while I was surveying the line traveling northerly toward him. We would meet in the middle and have as much of it tied as we could, hopefully the whole canyon, as I did not want to have to establish another control point somewhere in there.

I worked my way north, surveying the surface pipeline south and east of the mouth of the canyon, and climbed from the canyon bottom onto a plateau with an elevation greater than 7,050 feet but ultimately lost the RTK radio link at the point when I drop below the north rim of the plateau. I was at an elevation of 7,063 feet, and 3.1 miles as the crow flies from my base and 517 feet higher in elevation. Where was Dave? I did not see him all day! We should have met somewhere in, or near the south end of the canyon. I did not think it was possible that we missed one another. I was happy to have gotten that stretch through the canyon

surveyed, even if there were a couple tough spots for radio reception. But now I was concerned that I had lost a man.

We all know that cell phone coverage is pretty poor in much of Wyoming. But it is getting better. In fact we have found that text messaging is a good way to communicate where coverage is spotty. I decided to text Dave. "Where are you?" It went through and he replied back. I expected to receive a message telling me he was at the truck, with GPS troubles or something. His response was that he did not lose radio link anywhere and that he thought he was at the north end of the job. "The pipeline ends at a little building here". Now, Dave had not been to the north end of the job, so he did not know for sure. I thought he was full of bologna. How could he have maintained radio link up through the canyon, over the 500'+ high ridge which was a mile across, down the other side through a valley at an elevation of 6,800', up the rim of circle ridge (7,050') and down another 150' into the basin below to a point an even 5 miles from the base? There was just too much terrain in there to make that reasonable, especially after the poor radio reception we encountered the previous day.

"OK Dave, just start shooting the line back toward me, I am headed for the truck but I flagged where I left off so you do not have to tie what I already have shot." We would sort out just where he was when I got the points plotted.

Sure enough he had made it all the way. He said "You told me to go until I lost radio link!" I never dreamed that he would cover the entire remainder of the job. My project plan had been to tie the pipeline over the course of two days. That plan was shot to pieces in my mind after the problems of the first day. On the morning of field day two I was expecting that we would be lucky to have the line surveyed in three field days. At this point, after getting an unexpected amount of range, we were back on track. The pipeline was surveyed! With the more modern Leica Viva rover I was outside of radio range two miles short of where Dave ended with the trusty old Leica 530 rover.

The remainder of this project was spent searching for corners; almost all those found were original stones. As usual some were well marked stones and others ranged from well set but seemingly

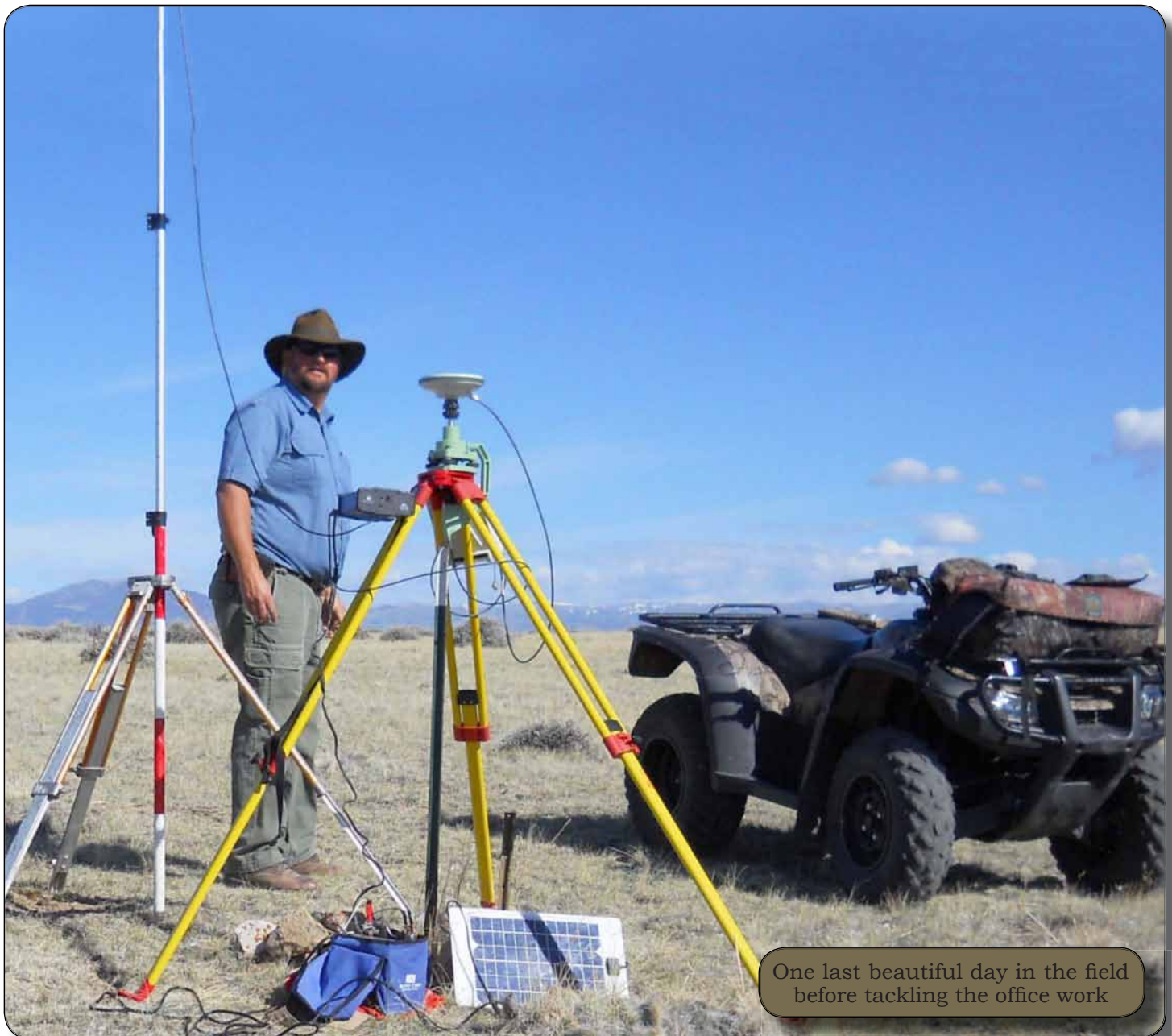
unmarked to broken shards. There are not many roads into this area and it was very enjoyable to travel around using an ATV seeing the land and finding the corner evidence.

The field surveying was completed and the office work had to be finished. I fit the 9.1 mile line on a 24" x 36" mylar exhibit with the appropriate certificates and tangent and parcel tables. There was some e-mails with pdf files to give the client a chance to look things over and to get the notary certificates correct for the State of California. After initial contact with the BIA right-of-way office to get the Title Status Reports, I maintained communication to make sure that the map format was appropriate for their needs. I like to take a job such as this from start to finish, field and office,

and in this case was able to do so. In the end the mylar was to be filed with the BIA, along with a narrative description across each parcel, and corner records in the queue for filing with the county.

We were then able to move forward with the inactive line survey using the control already established and the same methods in the field. Another opportunity to get away from the beaten path and search original corners. In the end, we mapped over 23 miles of pipeline, and recorded nearly 30 corners. A job that let us get into some new country, and provided a funny story about what could result from telling someone,

"Just go until you lose radio contact".



One last beautiful day in the field before tackling the office work

RDO Integrated Controls offers

THE FASTEST TRACKING GPS SYSTEM ON THE MARKET!



SOLUTIONS PROVIDER GIS | Survey | GPS | Laser | Machine Control | Mobile Mapping

The next generation in GNSS receiver technology

- Industry leading satellite acquisition speed
- G3 Tracking the most reliable under cover
- 216 Universal Tracking Channels
- High accuracy RTK technology with position updates up to 100 Hz

GR-5



MAGNET™

Field and Office. Connected.

The software solution that streamlines the workflow for surveyors, contractors, engineers, and mapping professionals. Magnet Field is controller software that will increase your productivity and connect you to others in the field as well as in the office. Magnet Enterprise is a web browser-based environment that simplifies managing field and office data in the cloud. Magnet Office is a stand-alone processing and CAD solution for surveying and grading applications.

Tesla Data Collector with **MAGNET™**

Topcon's newest larger screen data collector, Tesla, has the advantages of a tablet PC and a rugged handheld computer in one.

- Large 5.7" color touchscreen
- 256Mb RAM, 4 GB flash storage
- Waterproof and Dust proof
- Windows Mobile® 6.5.3 Professional operating system



ARIZONA • CALIFORNIA • HAWAII • MINNESOTA • MONTANA • NORTH DAKOTA • SOUTH DAKOTA • WYOMING

Toll Free 877-90 RDOIC

www.rdoic.com
www.rdomarketplace.com

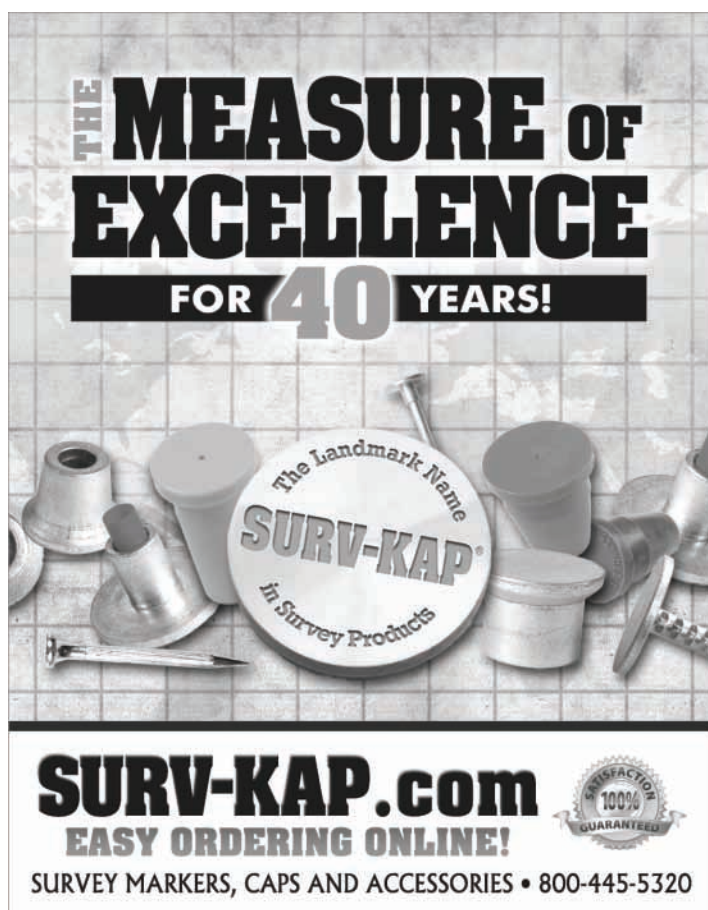
 **TOPCON**

YOU'VE USED THEM, BUT CAN YOU PLACE ALL TWENTY-THREE?

Well, I'm not sure how long to let everyone keep searching out all the county court houses. Not a single person has asked what the answers are for the picture "Match Game" that I challenged. But I'm going to give them to you anyway. In case you missed it the game started with the door handle pictures in the July, 2012 (Volume 23: Issue 3) issue of Lines & Points. Hope someone enjoyed it like I did!

Michael Flaim, PELS

Photo	County	Seat City/Town	Number
A	Sweetwater	Green River	4
B	Uinta	Evanston	19
C	Big Horn	Basin	9
D	Sublette	Pinedale	23
E	Converse	Douglas	13
F	Crook	Sundance	18
G	Laramie	Cheyenne	2
H	Hot Spings	Thermopolis	15
I	Carbon	Rawlins	6
J	Washakie	Worland	20
K	Park	Cody	11
L	Natrona	Casper	1
M	Campell	Gillette	17
N	Teton	Jackson	22
O	Albany	Laramie	5
P	Johnson	Buffalo	16
Q	Fremont	Lander	10
R	Weston	Newcastle	21
S	Sheridan	Sheridan	3
T	Niobrara	Lusk	14
U	Goshen	Torrington	7
V	Platte	Wheatland	8
W	Lincoln	Kemmerer	12



THE MEASURE OF EXCELLENCE
FOR 40 YEARS!

SURV-KAP.com
EASY ORDERING ONLINE!
SURVEY MARKERS, CAPS AND ACCESSORIES • 800-445-5320

ATTENTION! SAFETY MANUAL FOR SURVEYORS



NOW AVAILABLE FROM THE SW CHAPTER
OF PROFESSIONAL LAND SURVEYORS OF WYOMING

COMPREHENSIVE, AFFORDABLE, ADAPTABLE!
Special Offer - Only \$50 + \$2 SHIPPING!

CD CONTAINS ENTIRE 206 PAGE MANUAL IN
BOTH "WORD" AND ADOBE ".pdf" FORMATS
THAT CAN BE EDITED AND ADAPTED
FOR YOUR PARTICULAR USE

Contact: Olian T. Shockley
(Olian_Shockley@msn.com or phone 307-875-0146)





Geodetic Surveying: Part III *Growing Pains*

Herbert W. Stoughton, PhD, PEELS, CP

Geodetic Engineer

With the completion of the arcs of Lapland and Peru, the age of discovery in the physical, natural, and mathematical sciences was unfolding. Besides the Royal Society of London and L'Académie Royal des Sciences, there were learned societies established in Berlin, Rome, Florence, Dresden, St. Petersburg, and Vienna in the seventeenth and eighteenth centuries. Although the Royal Society and L'Académie were the most prominent, the other societies contributed significantly to scientific thought and knowledge.

The Greenwich Observatory was founded in 1675 and the Paris Observatory was established in 1667. Thus, two of the world's greatest astronomical observatories commenced a long journey of scientific discovery into the origins of the universe. Later, observatories in Russia, Germany, Austria, Italy, Spain, and Cape of Good Hope, to name a few, were established. These observatories carefully mapped and observed astronomical phenomenon. Precise time and accurate celestial positions were major goals. With these data, geodesists and surveyors would be able to accurately determine geographic position.

The observatories were provided with teams of astronomers and technicians, and volumes of data were generated. Instrument makers worked diligently to improve the precision and accuracy obtainable. These improved data produced multiple values for the same quantities. Investigators initiated studies on how to report the results and quantify the accuracy. Thus arose the mathematical disciplines of probability theory and statistics.

After the triangulations of Snellius, Picard, Lapland, and Peru had been completed and the results published, it became apparent that all the work contained significant discrepancies. Study of each project generally indicated there was no standard (acceptable) procedure and instrumentation for observing and computing triangulation. For instance, the measured triangles were tilted to the horizon, instrumentation produced large positional eccentricities, etc.

Although great care was exercised to reproduce copies of the reference toise (known as the toise of Peru and the toise of the North), there was only a rudimentary understanding of metrology and the behavior of materials.

The mathematicians of the last half of the eighteenth century then began a serious investigation and analysis of the sources and magnitudes of the errors. Their investigations compared geometrical theory with actual implementation. The results were far reaching. By the end of the Hundred Years wars the geometry and functions for theodolites were precisely defined and the observing programs formulated.

In Great Britain, William Roy (4 May 1726 - 1 July 1790) commenced his career as a civilian draughtsman in the Ordnance Office in Edinburgh. After the political unrest in Scotland, the Deputy Quartermaster-General recommended completion of a map of Scotland to assist in the pacification of the Highlands. From 1747 to 1752, Roy completed the mapping of the Highlands. Between 1752 and 1755 Roy worked on mapping the Lowlands, or southern Scotland. The survey of Scotland was a landmark in British cartography. It would serve as a model for the mapping of Canada and the St. Lawrence (1760 - 61); East Coast of North America (1764 - 75); Bengal (1765 - 77); and Ireland (1778 - 90). In 1755, Roy joined the British Army and served in the Engineer and Quartermaster Corps.

In 1783, César-François Cassini Thury III (17 June 1714 - 4 September 1784), who was director of the Paris Observatory, suggested to King George III a triangulation of southeast England to connect the Paris and Greenwich Observatories. The earlier triangulation of France had been completed to Calais - Dunkirk region. All that was required was triangulation from London to the coast near Dover and across the English Channel. The King forwarded the request to the Royal Society of London, where the project was approved. The Royal Society immediately proposed that General Roy should take charge of the project. The project was initiated with the survey of the base line at



Figure 1. The Great Theodolite of Ramsden.

Hounslow Heath in 1784. Jesse Ramsden (1735 - 1800) constructed an experimental steel chain which produced a measured length of 27,408.22 feet (June 1784). During that time the accepted base apparatus was a deal rod (a type of wood rod approximately 20 feet in length, with ball metal tips at each end. The deal rod measurements produced a length of 27,406.26 feet. Study of the deal rods indicated that the rods changed length due to the hygrometric state of the local atmosphere. The next attempt was to measure the base with glass rods. The result was 27,404.0137 feet. Analysis of the glass rod apparatus indicated extreme flexure of the rods during measurements. Ramsden produced two 100-foot chains of 40 links each. The field procedure was identical to precise taping baseline techniques adopted in the late nineteenth and twentieth centuries. The final result was 27,404.24 feet. The coefficient of linear thermal expansion employed was 0.0000 0625 (compared 0 0.0000 0645 used today). In three papers published in the Philosophical Transactions of the Royal Society of London (1785, 1787, and 1790), General Roy concisely set forth the procedures to produce accurate triangulation.

In order to measure accurately and precisely the angles in the network General Roy commissioned Jesse Ramsden to design and construct the "great theodolite". Ramsden was the foremost instrument maker in England. He developed procedures and machines which provided accurate divisions for mathematical instruments. He was the first to use verniers on circular instruments. The great theodolite (1787) had a 36-inch circle and weighed 200 pounds. It was the first theodolite capable of reading a signal at 70 miles with an angular error of two arc seconds. The theodolite was employed by the Ordnance Survey from 1799 to 1853.

A second "great theodolite" was made by Ramsden in 1791, and owned by the Royal Society. The Ordnance Survey's "great theodolite" was destroyed due to bombing in World War II. These two theodolites could be read directly to one arc second and estimated to one-tenth arc second. Ramsden also constructed an eighteen inch theodolite with the circle reading capability of ten arc seconds. The fourth theodolite employed by the Ordnance Survey was a twenty-four inch model designed and made by Troughton & Simms.

The first portion of the triangulation was to connect the Greenwich Observatory with the Paris Observatory. Major General Roy was in charge of designing and connecting the network from Greenwich and Dunkirk. Complete details for the survey were published in the Philosophical Transactions of the Royal Society of London.

Although the Ordnance Survey was not founded until 1791 and after General Roy's death (1 July 1790), it was Roy's administrative leadership which established the tone of the Ordnance Survey's programs. Under the directorships of Col. Edward Williams: 1791 - 1798; Maj. Gen. William Mudge: 1798 - 1820; Maj. Gen. Thomas Colby: 1820-1847; Col. Lewis Alexander Hall: 1847 - 1854; and Maj. Gen. Henry James: 1854 - 1875, the Ordnance Survey completed the triangulation of the United Kingdom and the geodetic leveling network. The results provided a rigorous geodetic network of horizontal and vertical points upon which the national map would be referenced. There were 218 triangulation stations, seven baselines, thirty-seven latitude determinations, and thirty-one astronomic azimuths observed for the network. Lieutenant Colonel William Yolland

(17 March 1810 - 5 September 1885) directed that the triangulation be reduced according to the method of least squares. Alexander Ross Clarke (16 December 1828 - 11 February 1914) stated that there were 1,554 directions and 920 condition equations for the network. Clarke divided the project into twenty-one networks (or figures) with the largest containing twenty-nine stations which contained sixty-three conditions.

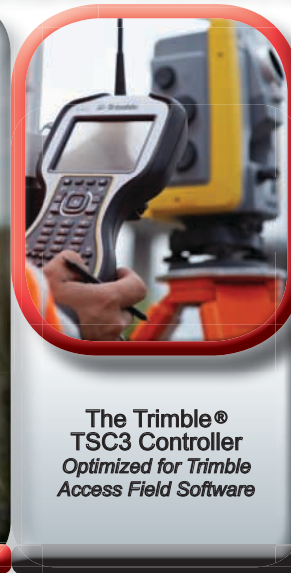
At approximately the time of the formation of the Ordnance Survey, Jean-Baptiste-Joseph Delambre (1749 - 1822) and Pierre-Francois-Andre Méchain (1744 - 1804) set out from Paris to measure an arc of triangulation between Dunkirk and Barcelona. Their objective was to determine the length of a meridional arc from the equator to the pole. A new standard of length called the meter, or metre, would be one ten millionth part of this arc length. Méchain with Andrien-Marie Legendre (1752 - 1833) and Jean Dominique Cassini (1748 - 1845) were appointed by the French Academy of Sciences to determine the length of the meter. Méchain took the triangulation south of Paris and Delambre was assigned the network between Paris and Dunkirk. These individuals attempted to utilize many of the survey stations established in Picard's original survey.

The two expeditions set out in 1792 during the height of the reign of terror of the French Revolution. The team members were harassed by Robespierre's Republican forces. Both parties finally completed their efforts. Unfortunately, Méchain was not up to the task. Méchain died on 19 September 1804, apparently from malaria. Méchain had been reluctant to publish his observations and calculations. Four months after his death, Méchain's papers, formulas, calculations, and notes were given to Delambre for compiling what knowledge he could. Earlier in the project Méchain had relied on another team member to perform some calculation, which were incorrectly done. This caused him to not rely on anyone's work but his own. This would be his undoing. Delambre discovered a discrepancy between the latitude results for Barcelona and Mount-Jouy. Méchain executed a systematic effort to cover up the discrepancy. Observations were ignored and the scientific results rewritten. Méchain had fudged the data. From 1806 - 1810

Delambre meticulously attempted to piece together all the scraps of paper containing observations. Eventually, Delambre discovered that Méchain had miscalculated the results. The observations were acceptable. When Delambre had completed volume 2 of the report, he had hypothesized the cause of Méchain's problems with the observations. The work recently completed by General Roy and the Ordnance Survey indicated that there were irregularities or variations in the latitudinal differences along different meridians. Delambre reasoned that Méchain's observations had been distorted by local inequalities due to local gravimetric attractions caused by varying densities in the local earth's crust caused by neighboring mountains. Newton had attempted to estimate the gravitation's pull of mountains more than a century earlier but was unable to provide quantitative results. The earlier work from Dunkirk to Malvoisin passed through the plains of France which avoided mountains and the associated problem of deflection of the vertical.

The French work introduced a new instrument which directly indicated the deflection problem. The instrument was the repeating theodolite. Jean-Charles de Borda (1733 - 1799) invented the repeating theodolite using a vernier to read the angles. The angular data produced was far superior to the data produced by Picard and the Cassinis. Another problem was discovered by the astronomer Jean-Nicolas Nicollet, who performed an in depth analysis of Méchain's astronomic observations. Nicollet employed newly published stellar ephemerides which were more accurate than those available to Méchain. The concept of systematic errors was not fully understood by Méchain and Delambre. Nicollet was a student of Pierre-Simon Laplace (1749 - 1827). Laplace wrote the most definitive treatise on the mathematical theory of probabilities entitled *Théorie analytique des Probabilités* (1812). Chapter 4 (pp. 304 -348) contains the theory which is later called the method of least squares. The intense review of Méchain's work pointed out the problems of planning, observing, and reducing triangulation. Although Méchain's work was acceptable, the next generation of geodesists would revolutionize and improve the theory, methodology, and data reduction for triangulation networks. The initial steps had been initiated by Legendre in the mid 1780's.

TECHNOLOGY FOR INFORMATION AND MEASUREMENT



FRONTIER PRECISION, COMMITTED TO THE GEOSPATIAL COMMUNITY SINCE 1987.

- Market Focused Solutions
- Technical Expertise to Serve you Better
- Toll Free Technical Support Number
 - ➔ Colorado/Wyoming/Montana 888.960.7934
- Technical Survey Blog at www.fpisurvey.com
- Trimble Certified Training Classes
- 3 Regional Service Centers

Frontier Certified Service Center

Cheyenne, WY | Denver, CO

800.652.1522

www.FrontierPrecision.com



seco

