WHEN THE STARS INTERRUPTED THE RUNNING OF A MERIDIAN LINE NORTHWARD UP THE DELMARVA PENINSULA [1]

THOMAS D. COPE

Professor Emeritus of Physics, University of Pennsylvania

ARTICLES published in *Library Bulletins* from 1948 to 1955 have told of incidents in the final survey of the Baltimore-Penn boundaries. The article of 1955 [2] is concerned principally with the events of 1760, 1761, 1762, and 1763, when provincial surveyors were attempting to lay out and mark the south to north boundary between Maryland and "The Three Lower Counties" (now the state of Delaware). The commissioners of both Maryland and Pennsylvania, who had been appointed in July, 1760, had met together for the first time in New Castle on the Delaware in November, 1760, and had agreed upon plans for the immediate future. They then adjourned to meet a few days later at the Middle Point, now the southwest corner of Delaware. There and then the Middle Point was located from records of the survey of 1751 and was marked by posts and a stone monument.[3] The surveyors, who had been chosen from Maryland and from Pennsylvania, were then instructed to run a meridian northwards from the Middle Point until a place was reached from which the spire of the courthouse in New Castle could be seen clearly. The article which now follows tells of the running of the meridian, which began on December 11, 1760, and continued until December 18. Work was then adjourned until more favorable weather should prevail. It was resumed on the following May 1 and was continued, with occasional interruptions, until completed on November 2, 1761.

The meeting of the Commissioners representing Maryland and Pennsylvania had convened at New Castle on November 19, 1760, and daily sessions had continued until November 24. On the latter date it was decided to end the sessions in New Castle and to reassemble eight days later at the house of Benjamin Venables, in Somerset County, Maryland, near the Middle Point, on December 2, there to proceed to determine and mark the Middle Point. That accomplished, the meridian of the Middle Point would be established and the surveyors would be charged with the problem of extending it up the peninsula toward New Castle.

During their final session at New Castle held on the afternoon of Monday, November 24, the Commissioners adopted eight resolutions. From them the following statements are abstracted:

3. ". . . the Meridian shall, if it can be conveniently done, be taken . . . by an observation of the Star Alioth the polar star and a Lanthorn. . . ."
4. ". . . the Meridian . . . shall be run and laid out by Plumbed Staves made according to the Figure now lying on the table . . . or by such other method as the Commissioners on the spot shall approve of."
5. ". . . it will be best to permit the Surveyors to use a chain . . . in measuring the said north Line . . . it is agreed that a chain or chains (being first and often afterwards care-

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[2] *Proc. Amer. Philos. Soc.* **99** (4): 268–276, 1955.

[3] Minutes of the Commissioners, 1760–1768; original copy in the Land Office, Annapolis, Maryland, described by Burchard and Mathews as "the only original and only complete copy . . . that has been thus far found," *Maryland Geological Survey* **7**: 353, 1908.

The Library of the American Philosophical Society owns two copies of these minutes. One is a photographic film copy made recently from the original in the Land Office, Annapolis. The other is a manuscript copy, "taken from an authenticated copy in the possession of Ferdinand R. Hassler," presented to the Philosophical Society in 1844 by George M. Justice. At the end of the manuscript copy stands the following statement:

"The foregoing is a true copy of the original Record in this office (with the exception of the names of the Commissioners signed to each days proceedings). I omitted the names at the request of J. H. Alexander Esq. for whom this Copy was made.

Annapolis, Maryland 'The Copyist?'"

The photographic copy and the manuscript copy have been compared word by word by the writer aided by Mr. Murphy Smith and Mrs. Barbara Sevy of the staff of the Library of the American Philosophical Society. The two copies are identical except for a few trivial items, such as are to be expected in the work of a copyist.

fully measured with a two foot brass sector now produced by the commissioners from Philadelphia as a Standard Measure) shall be used when convenient, and where the ground shall be level, and when Hills or uneven Ground shall intervene it is agreed that the Surveyors shall pursue proper methods in order to take the Horizontal Distance or measure agreeable to the Instructions that may be given them when the Commissioners meet. . . ."

6. ". . . any method or methods which may be used . . . in running the North Line . . . shall not be pursued in running any lines that may be afterwards run, unless . . . expressly agreed on . . . and adopted. . . ."
7. Surveyors "shall be instructed to take a meridian frequently . . . after the manner described. . . ." Instructions were given about how to proceed in case errors in the line should be detected. Other methods of finding the Meridian might be used if the surveyors agreed and the methods could be shown to be sound.
8. Surveyors were instructed to set up and fix good sound posts along the north line at each mile from the Middle Point.

During their eight-day meeting at or near the Middle Point the Commissioners interviewed two surveyors who had participated in running the east-west transpeninsular line from Fenwick Island to the Chesapeake in 1751 and with their aid located the Middle Point of the line and marked it with a hewn white oak post set firmly in the ground. Surveyors who had been chosen to run the line northward were at hand. Equipment that they had prepared was examined.

Two boundary stones bearing the arms of Baltimore and the Penns on opposite faces were brought to the Commissioners. One was set two feet eight inches north of the Middle Point and the other was used to replace a post which marked thirty miles due west of the initial marker on Fenwick Island.

On Saturday evening, December 6, 1760, the surveyors found the meridian of the Middle Point by use of a theodolite, plumb-line, and lantern, and by observation of Alioth and Polaris when they stood in a vertical line. On the following Monday this meridian was marked by two posts, one 20 perches north of the Middle Point the other 34 perches to the north of the same point. The Commissioners decided to participate in a recheck of the meridian but cloudy skies gave them no opportunity. A vista was ordered cleared northward.

December 9 and 10 the Commissioners spent in office work. On Thursday, December 11, the surveyors reported that they had redetermined the meridian. The posts previously set to mark it were then moved slightly to accord with the redetermination. The surveyors at hand took oaths to perform their work. They were:

for Lord Baltimore	for the Penns
John Frederick Augustus Priggs	John Watson
	John Stapler
Thomas Garnett	William Shankland
Arthur Emory 3rd	

William Dending and George Brown were sworn in as chain carriers.

As a final act the Commissioners handed to each group of surveyors a long letter of instructions, each the duplicate of the other incorporating all the resolutions adopted at New Castle on November 24 and the additional instruction to keep minutes of the field work[4] in duplicate, drawn up daily and signed by all the surveyors who were on duty. The Commissioners then adjourned and the survey was underway.

The method for establishing a meridian which the Commissioners preferred is illustrated in figure 1.[5] The scenes sketched are ones that an observer in latitude 40 degrees north may view during any clear night except during June and July. As the Earth rotates the stars appear to wheel around the pole of the heavens. Any pair of stars must twice in twenty-four hours determine a vertical line in some latitudes, which may nearly always be recognized by use of the familiar plumb-line.

The pole of the heavens, owing to the precession of the rotating Earth, moves slowly among the stars. For centuries, millennia even, it has been approaching Polaris. It will make its closest approach about the year 2100 A.D. and for millennia thereafter will move away.[6] About two hun-

[4] Field Books of the Provincial Surveyors. These books are preserved in the Land Office, Annapolis, Maryland. They contain day by day records of the work of the surveyors in December 1760 and during the working seasons of 1761, 1762, and 1763. The American Philosophical Society owns films of these records.

Burchard and Mathews say of these Field Books: "the only complete original or complete copy that has been found." *Maryland Geological Survey* 7: 337 and 342, 1908.

[5] In figure 1, the pole of the heavens, rather than Polaris, should stand at a constant elevation above the northern horizon.

[6] A well illustrated, readable account of the Earth's precessional motion and of the motion of the pole of the heavens among the stars is given in R. H. Baker's

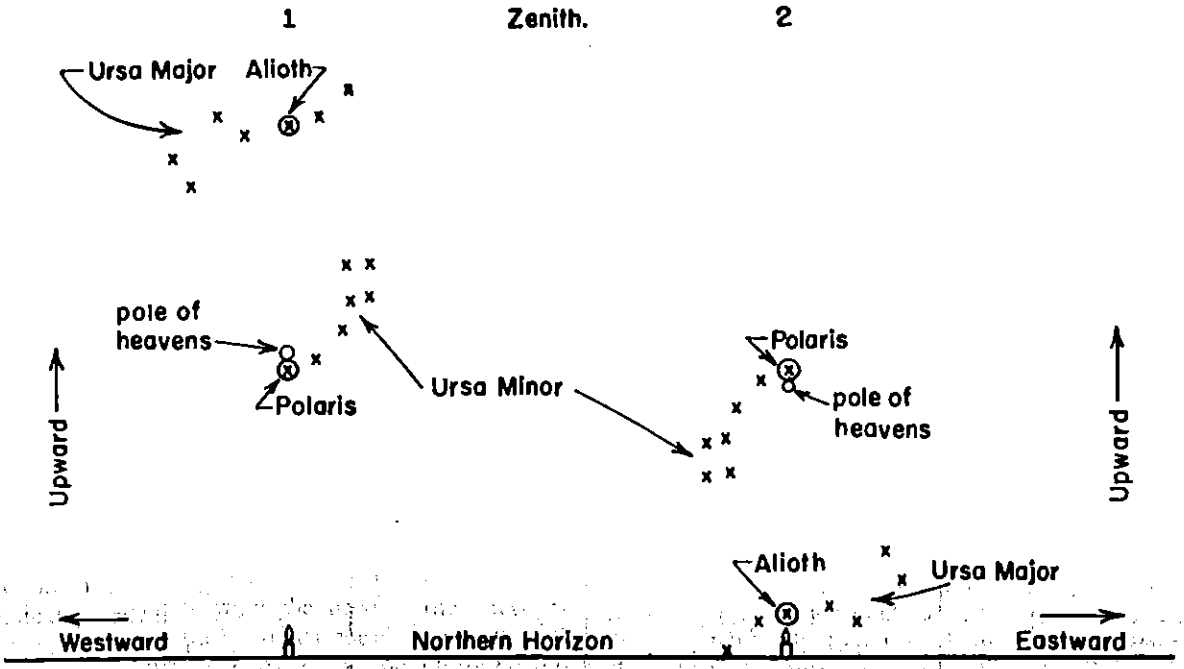


Figure 1.

about		about
5 A.M.	January 15	5 P.M.
3 A.M.	February 15	3 P.M.
1 A.M	March 15	1 P.M.
11 P.M.	April 15	11 A.M.
9 P.M.	May 15	9 A.M
7 P.M.	June 15	7 A.M.
5 P.M.	July 15	5 A.M.
3 P.M.	August 15	3 A.M.
1 P.M.	September 15	1 A.M.
11 A.M.	October 15	11 P.M.
9 A.M.	November 15	9 P.M.
7 A.M.	December 15	7 P.M.

FIG. 1.

dred years ago the pole of the heavens was almost following the arc of the great circle that passes through Alioth and Polaris.[7] Hence, at that era, and fairly accurately so now, a lantern, seen back of a plumb-line that appears to pass in front of both Alioth and Polaris, marks the projection of

Astronomy, 5th ed., New York, Van Nostrand, 1950. Prof. F. Bradshaw Wood suggested this reference.

[7] Consult *Connaissance des Temps* for the right ascensions of Polaris and Alioth at five-year intervals from 1735 to 1800, and note on a diagram of the path of the pole among the stars that the line joining Polaris and Alioth is almost tangent to the arc traversed by the pole during the eighteenth century.

the pole of the heavens upon the surface of the Earth. The observer who looks at the plumb-line and sees back of it Alioth, Polaris, and the lantern is looking northward along the meridian of the spot where he stands, or sits.

The first record made by the provincial surveyors was written at the Middle Point on December 12, 1760. It reads:

About $7^{H}2^{M}$ P.M. we observed Alioth transit the Meridian at which time Our Lanthorn, that Star and the Pole Star were cut by the plumb-line which was hung up the 10th Instant hence we conclude the Meridian truly found, and the aforesaid North line rightly begun

J. Watson	John F. A. Priggs
Jno. Stapler	Tho. Garnett
Wm. Shankland	Arthur Emory 3rd
for the Penns	for Baltimore

On December 16 the surveyors were halted by rain and erected a stage for getting a meridian between 4 and 5 miles north of the Middle Point. The observation was made on the following evening. The record reads:

. . . having placed our Plumet and Lanthorn in our line . . . about $7^{H}1^{M}$ P.M. we were very greatly surprised to observe Alioth transit our line and the Meridian at one and the same Minute from which concluded the direction of the line as begun at the post marked (Middle) rightly preserved to this place.

Watson	Priggs
Stapler	Garnett
Shankland	Emory

On December 18 wintry weather had set in. Priggs was seriously ill. The River Nanticoke lay just to the north. The surveyors marked the meridian which had been observed on the previous evening with stout posts set in the ground on small hills; one post was marked 1760. Accounts with laborers were settled and the chain was measured. The surveyors then ceased work for the season.

They resumed work on the first day of May, 1761. Laborers were hired, provisions were secured and so on. On May 5 they record:

. . . this evening [the first clear one since they had returned to work] repaired to the two posts set up on the 18th day of December last to preserve the direction of our line, and found by a Meridian taken at the first of them, we had continued a true North line from the post marked (Middle) to the last of them marked (1760)

Watson	Garnett
Stapler	Emory

During the following week the surveyors worked northward across swamps and thickets, crossed the Nanticoke and continued northward. Their records for May 12 and 13 are interesting. They are quoted in part.

[. . . continued the line to] a white Oak post squared and marked M/XI, thence 34 chains where we hung a plumet for taking a Meridian which we took between Nine and Ten [PM] and found the direction of our line exactly to agree therewith.

After placing the posts as instructed where we took a Meridian last night continued our line . . . set up a squared White Oak post markt M/XII . . . thence to another White Oak post hewn and marked M/XIII. Thence 11 chains and 26 links set up a Stage to take a Meridian and found it to coincide with the line we were Runing

Watson	Garnett
Stapler	Emory

A trifling incident recorded by the surveyors on May 16, 1761, made a lasting impression upon Proprietor Thomas Penn, who entertained no great enthusiasm for provincial technologists. The account of the surveyors says that the short telescope of Governor Horatio Sharpe's theodolite had been used to extend the North Line from the Middle Point to the River Nanticoke. It was there found to be too short to discern distinctly both a plumb-line near at hand and the top of a staff across the river. The surveyors improvised a support for a telescope four and one-half feet long when extended and used it to view in one field both the nearby plumb-line and the tops of staves at far greater distances than with the other telescope. It proved to be of singular use in ranging the tops of staves not only in crossing the river but on the Line thereafter until this afternoon. Having been wet in the previous day's rain it began to cast a band and to represent objects in a situation somewhat different from what they really possessed. Experiments with it took up the whole afternoon of May 18. This account is signed by Watson and Stapler and by Garnett and Emory. In due course Thomas Penn in England learned of the event.

Mr. Penn wrote regularly to Provincial Governor James Hamilton, and Mr. Penn admired his surveyors, John Watson and John Stapler. The untimely death of the former and a disabling illness which obliged the latter to withdraw from the survey were blows to Mr. Penn and drew from him expressions of deep regret. Yet in a letter [8]

[8] Penn Letter Books, 7: 270, at Historical Society of Penna.

to Governor James Hamilton, Mr. Penn said on May 23, 1763:

> I hope we shall agree to send Surveyors from hence, to run all the rest, it is amazing that the Surveyors were so ignorant as to run the Meridian Line with a Wooden Telescope that was left abroad in Wet Weather.

Now and then Proprietor Thomas Penn could enlarge a molehill into a mountain.

The meridian was advanced northwards through the month of May and into June. An inspection of the table which accompanies figure 1 will show that, during June and July, Alioth and Polaris stand in vertical lines only during daylight hours (in mornings and evenings). Mention of this phenomenon began to appear in the records of the surveyors early in June. Attempts to establish meridians on June 1 and again on June 5 by observations of Alioth and Polaris were frustrated by daylight. A different way of establishing the meridian had to be tried. The surveyors' records of June 6 and of the six days following tell the story.

On June 6, 1761 the surveyors record that:

> The loss of our old Guide (tho much regretted) was not altogether unexpected; and to prevent any delay the want of her might cause, had previously calculated the Requisites for Approximating to a Meridian in a new way. We rose about 20 Minutes after one in the morning, and notifying our Watches by the Culmination of the bright Star [Vega] of the Harp [Lyra], near 21 Minutes after being the Time of the Pole Star's greatest deviation,[9] placed a Candle and Lanthorn in the Range of our Stage plumline and Pole Star. After Day Light applyed ourselves to getting a pole suitable to measure the Divergency of the Range of our plumline and Lanthorn from the Meridian. Then measuring it thereon found the Course ran on the Third Instant made an Angle with the Meridian (so found) of 3'56" Westerly. . . . agreed to repeat our Observation by the Pole Star in its greatest Deviation; if possible to discover whether the Error lay in the Line, or Meridian taken.
>
> Watson Garnett
> Stapler Emory

The observation was repeated in the early morning hours of the following day, Sunday, June 7, with complete confirmation of the previous day's results. On June 1 a meridian had been taken on the Line near the post set to mark 23 miles north of the Middle Point. On June 8 it was decided to check the meridian at that point by using the technique recently adopted. The surveyors returned to their station of June 1 and made preparations for the check of the meridian but unfavorable weather which lasted for several days prevented it. They used the time to rerun the Line from the station of June 1 northwards. By June 11 they had reached their station which was occupied on June 6. There during the early morning hours of June 12 they

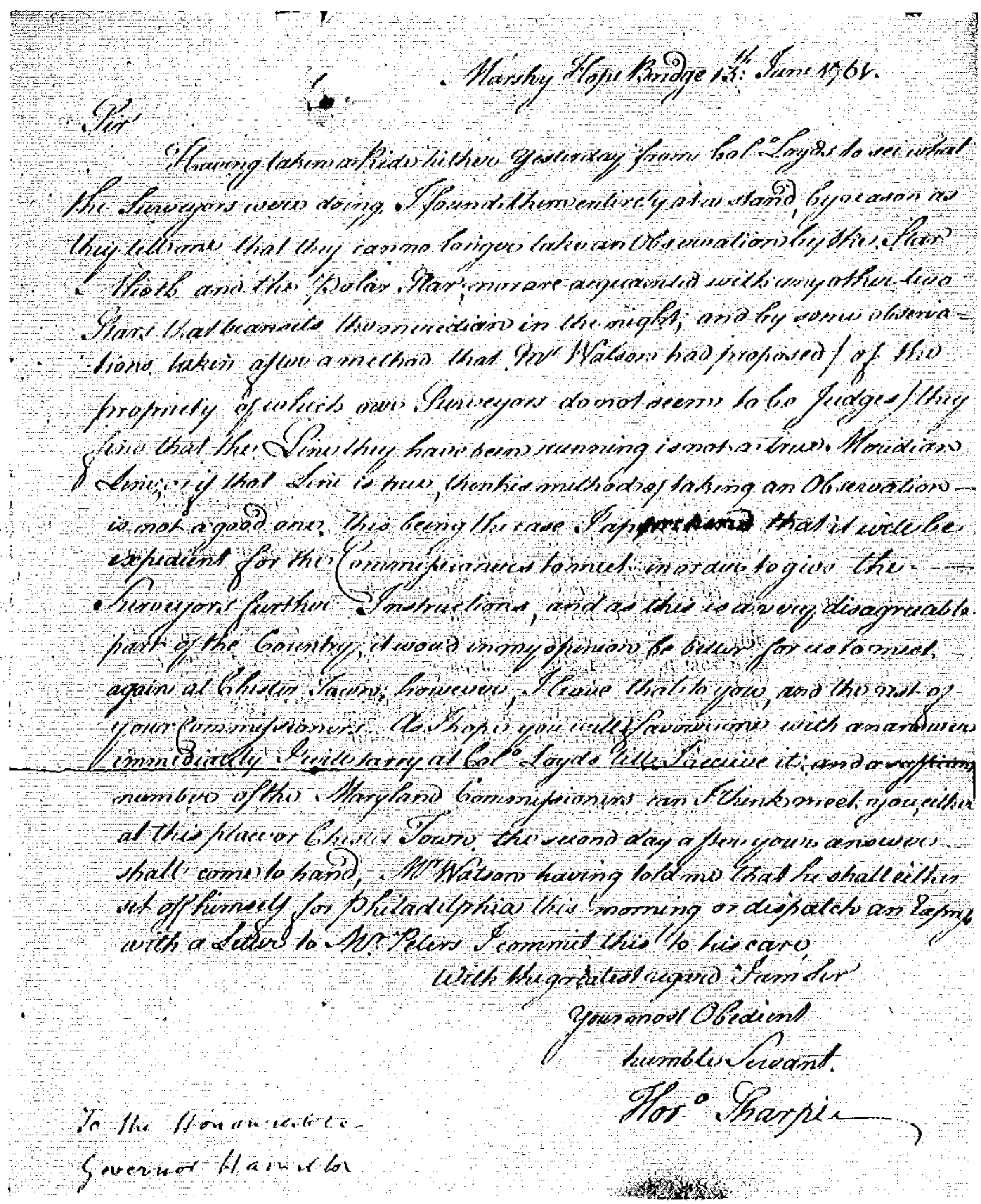
> took a Meridian in the new way and by comparing the course we were Runing therewith found oure line made an Angle with the Meridian of about 1'16" to the East.
>
> Watson Garnett
> Emory

At this juncture Governor Horatio Sharpe of Maryland, the leader of Lord Baltimore's commissioners, visited the surveyors. He tells his story in a letter which he wrote on June 13, 1761, to Governor James Hamilton of Pennsylvania. It is here quoted in its entirety and in facsimile. Its existence is referred to in the Minutes of the Commissioners.[10] The letter has apparently not been published among the official correspondence of Governor Sharpe in the *Archives* of *Maryland*. Recently the original letter was acquired by the Library of the American Philosophical Society.

> Marshy Hope Bridge 13th June 1761
>
> Sir
>
> Having taken a Ride hither yesterday from Colo Loyds to see what the Surveyors were doing, I found them entirely at a stand, by reason as they tell me that they can no longer take an Observation by the Star Alioth and the Polar Star; nor are acquainted with any other two Stars that transits the meridian in the night; and by some observations taken after a method that Mr. Watson had proposed/ of the propriety of which our Surveyors do not seem to be Judges/ they find that the Line they have been running is not a true Meridian Line; or if that Line is true, then his method of taking an Observation is not a good one. This being the case I apprehend that it will be expedient for the Commissioners to meet in order to give the Surveyors further Instructions, and as this is a very disagreeable part of the Country, it wou'd in my opinion be better for us to meet again at

[9] Polaris wheels around the pole in a circle of small radius. With the aid of a telescope and a plumb-line the surveyors were placing a lantern directly beneath Polaris when at its greatest easterly elongation from the pole. From the angular radius of the circle described by Polaris they then calculated the angle between their meridian and their line of sight toward the lantern.

[10] Letter of Governor Sharpe to Governor Hamilton mentioned in Minutes of Commissioners, June 25, 1761.



Marshy Hope Bridge 13th June 1764.

Sir

Having taken a Ride hither yesterday from Col. Loyds to see what the Surveyors were doing I found them entirely at a Stand by reason as they tell me that they can no longer take an Observation by the Star Alioth and the Polar Star, nor are acquainted with any other two Stars that transits the meridian in the night; and by some observations taken after a method that Mr Watson had proposed (of the propriety of which our Surveyors do not seem to be Judges) they find that the Line they have been running is not a true Meridian Line; or if that Line is true, then his method of taking an Observation is not a good one; this being the case I apprehend that it will be expedient for the Commissioners to meet in order to give the Surveyors further Instructions, and as this is a very disagreeable part of the Country, it would in my opinion be better for us to meet again at Chester Town, however, I leave that to you, and the rest of your Commissioners. As I hope you will favour me with an answer immediately I will tarry at Col. Loyds till I receive it; and a sufficient number of the Maryland Commissioners can I think meet you either at this place or Chester Town, the second day after your answer shall come to hand, Mr Watson having told me that he shall either set off himself for Philadelphia this morning or dispatch an Express with a Letter to Mr Peters I commit this to his care

With the greatest regard I am Sir

Your most Obedient

humble Servant.

Hor° Sharpe

To the Honourable

Governor Hamilton

FIG. 2.

Chester Town, however, I leave that to you, and the rest of your Commissioners. As I hope you will favour me with an answer immediately I will tarry at Colo Loyds till I receive it; and a sufficient number of the Maryland Commissioners can I think meet you, either at this place or Chester Town, the second day after your answer shall come to hand, Mr. Watson having told me that he shall either set off himself for

Philadelphia this morning or dispatch an Express with a Letter to Mr. Peters I commit this to his care,

With the greatest regard I am Sir
Your most Obedient
humble Servant
Horo Sharpe

To the Honourable Governor Hamilton

End: 1761
Governor Sharpe
about Line

It may be said in comment that the method of finding a meridian recommended by Mr. Watson and tried by the surveyors during June, 1761, that of observing maximum elongations of Polaris and from them deducing the position of the pole, continues to be standard practice at the present day. Perhaps Governor Sharpe unintentionally paid his surveyors a doubtful compliment when he stated that they could not pass upon the merits of the method.

At their meeting held in Chestertown, Kent County, Maryland, on March 25 and 26, 1761, the Commissioners had found the work of the surveyors in December quite satisfactory and had adjourned to meet during the middle of summer. The letter of Governor Sharpe resulted in a call for a meeting of the Commissioners immediately. It was held in Chestertown on June 25 and 26. And it also caused a cessation of all work of surveying from June 12 until July 22. The commissioners instructed the surveyors to redetermine the meridian on July 15 at the station where they had determined it on May 22 by observation of Alioth and the Pole Star [21 miles north of the Middle Point] either by observation of the Pointers, or by equal altitudes of the bright star [Vega] in the Harp [Lyra], or by any other proper star. If this newly determined meridian should coincide with the line already run by observation of Alioth and the Pole Star then the surveyors were to extend it up the peninsula checking their meridian from time to time until transits of Alioth could again be accurately observed. Then they were directed to return to observations of Alioth and the Pole Star for finding the meridian. But if the meridian newly found should not coincide with that found by observing Alioth and the Pole Star, then the surveyors should wait until August 1, 1761, and then begin to extend the meridian northward as directed on December 11, 1760.

The Commissioners added instructions to remeasure three of the miles marked off, to keep exact accounts of the remeasurements, and to meet the Commissioners at New Castle on October 19 next bringing records of the remeasurements, and to redetermine the meridian at the 25 mile post after the redetermination ordered made on July 15 had been completed.

Three new surveyors appear at this time. Jonathan Hall succeeds Arthur Emory 3rd. And among the surveyors for the Penns death retires John Watson and illness John Stapler. They are succeeded by John Lukens and Archibald McClean, two men famous in the annals of boundary surveys.

The four surveyors, Stapler and Lukens, Garnett and Hall, resumed work on July 22. By July 24 the three miles which had been ordered remeasured had been found correct, and an observation had been made on the Pointers. On July 25 all four surveyors signed a statement:

. . . From experience to date concluded observations on the Pointers or the other proposed method impracticable with instruments now here. Decided to desist from further attempts until August 1, 1761.

On Thursday August 6, 1761

Met at place appointed where an Observation was taken by the Star Alioth on the 22nd of May last

Lukens	Garnett
McClean (relieving Stapler)	Hall

Two days later their record of the day's work reads:

Saturday August 8th, 1761

This morning being clear a little after 3 O'clock we repaired to our apparatus as fixed for taking a Meridian in the new way and there had an accurate Observation of Alioth transiting the Meridian under the Pole Star, when our Candle placed over the most northerly post there set up to preserve the Meridian appeared to the East, making an angle with the Meridian now taken of one Minute and Six Seconds which is occasioned by the said Post having lost the Direction in which it was first placed. We then repaired to the twenty five mile post near which we erected our apparatus in the direction of the line, formerly run in order to ascertain that part thereof by an Observation.

Jno Lukens	Th. Garnett
Arch McClean	Jona. Hall

On the following morning Sunday August 9:

This morning had an accurate Observation of Alioth and the Polar Star's transiting the Meridian in the precise point of view with our Lanthorn, as placed yesterday, from which we conclude the North Line is hereby continued up to this place.

Lukens	Garnett
McClean	Hall

The records of the days following tell of a steady march due northward up the peninsula. Streams and millponds are crossed, buildings that lie on the meridian are passed by parallel courses to the east or west. The records of September 15 and 16 are representative.

Tuesday September 15th, 1761

This morning measured our chain, afterwards proceeded with the Line 57 chains 77 Links to a Road leading from the Head of Chester River to Dover, thence 7 chains 23 Links to a squared White Oak Post marked M/LV, thence 15 chains 82 Links where we erected an apparatus for taking a Meridian, thence 64 chains 18 Links to a White Oak Post hewn and marked M/LVI, where Night came on.

Wednesday, September 16th, 1761

By a Meridian taken this morning at the Apparatus erected yesterday we found the Line run to coincide therewith, as heretofore, and after fixing two posts as instructed we extended the Line. . . .

Lukens	Garnett
McClean	Hall

Through September and well through October the surveyors pushed the meridian northwards without difficulties or delays. The Commissioners met in New Castle on Monday, October 19, and the four surveyors spent that day with them. The remaining days of the week the surveyors spent on the meridian pushing it six miles northward as their records show. The Commissioners took cognizance of where the surveyors were working and what they were doing. On the final day of the week, October 24, they issued a letter to the surveyors instructing them how to lay out, mark and measure the Line of Intersection and the angle between it and the meridian of the Middle Point.

The surveyors' record of Monday, October 26, reads as follows:

As it was judged we had extended the North Line so far that a Line run from the Center of New Castle to the southward of West so as to clear the River would intersect the same; after receiving farther directions from the Commissioners for running the said Line of Intersection we intended to proceed thereon, but were hindered by a heavy North East Wind and Rain.

Lukens	Garnett
McClean	Hall

As the meridian was completed as of this date only brief mention will be made of the work done before winter set in. During this period Commissioners and surveyors worked closely together. On October 31 the line run out from the spire of the courthouse in New Castle intersected the meridian. The point of intersection was securely marked. On November 2 and 3 the meridian of the point of intersection was found by observation of the stars. It was found to coincide with the North Line, or meridian of the Middle Point, and was marked by the usual two posts set firmly in the ground and at a considerable distance apart.

On Thursday, November 5, 1761:

Repaired to the place where the Line Extended from the spire or spindle on the top of New Castle Court-House, intersected the Meridian, or North Line, and there in presence of the Commissioners took the Angle included, between the said Line of Intersection and the said Meridian, or North Line, and found it to contain 112°36′. (The above Angle was taken with two theodolites the one belonging to the Honble the proprietaries of Pennsilvania and the other to the Estate of the late John Watson both of which agreed. . . .

Lukens	Garnett
McClean	Hall

On November 6 and 7 the surveyors proceeded to complete the measurement of the Line of Intersection from its point of intersection with the meridian of the Middle Point to the spire of the courthouse. On Monday the ninth Thomas Garnett was obliged to go to his home and Jonathan Hall learned that his wife was ill and left for home. For the entire week ensuing work was at a standstill.

On the following Monday, November 16, Hall returned to New Castle and he and Lukens and McClean began, as instructed by the Commissioners in a letter of November 7, to lay out and mark a horizontal line of twelve English statute miles from the Center of the courthouse in New Castle making an angle of nineteen degrees three minutes and fifty-five seconds northward with the line of intersection lately run. Either some of the Commissioners or some person or persons employed by them had made the calculations. On November 21 John F. A. Priggs, who had gone home ill in December 1760, joined the surveyors. One week later the four surveyors "fixed and secured firmly in the ground in the Meadow late Lewis Thomson's, a Squared White Oak post marked M/XII." This represented the first attempt to mark the Tangent Point, where the Tangent Line run from the Middle Point should touch the cir-

cumference of radius twelve miles encircling the spire of the courthouse in New Castle.

Faithful technologists that they were, Messrs. Priggs, Hall, Lukens, and McClean completely rechecked the horizontal line of length 12 miles that they had just laid out from the center of the spire of the courthouse at an angle of 19 degrees 3 minutes and 55 seconds northward with the line of intersection that they had laid out and measured during late October and early November. This work was completed on December 1. They record that "no mistake hath been committed." And on December 1 they

settled with and dismissed the Chain carriers and all the other Hands except the Steward, and Waggoner; then rode to Wilmington, there to take Account of and Deposite the Stores for the Winter Season.

And on Wednesday, December 2, 1761:

This day took Account of the Stores; stored them in Wilmington in the Care of John Stapler Esq.r settled Sundry Accounts dismissed the Steward and the Waggoner

Jn°. Lukens	John F. A. Priggs
Ar^d. McClean	Jona Hall

Field work for 1760 and 1761 had been completed.

To start the field work of 1762 the Commissioners for Maryland and Pennsylvania had the data accumulated during 1760 and 1761 and the conclusions derived from them, namely, the bearing of the Tangent Line and the position of the Tangent Point. The latter was securely and conspicuously marked, as was also the meridian laid out from the Middle Point. The entire working season of 1762 and the season of 1763, until word was received in early autumn that Charles Mason and Jeremiah Dixon were being sent by the Proprietors to take over the survey, were devoted to successive attempts to lay out and mark a line from the Middle Point to the vicinity of the Tangent Point as already marked, that would be accepted by both the Commissioners for Maryland and those for Pennsylvania as the Tangent Line. The procedure employed was one of successive approximations. From lines already established, first of all the meridian laid out during 1760, calculated offsets were made to create a new line which promised to be more nearly acceptable.

The Tangent Line, at the suggestion of both Proprietaries, was assigned to Mason and Dixon for completion. They worked on it from June to November, 1764. At the completion of this assignment they made the following entries in their "Field Notes":[11]

The portion of this record made in their "Surveys of the Boundary Lines between the Provinces of Pennsylvania, Delaware, and Maryland, 1763-68" was published by the Secretary of the Internal Affairs of the Commonwealth of Pennsylvania in 1887.

November 10, 1764 . . .

Produced the Line to the Point shewn us . . . to be the Tangent Point settled by the former Surveyors, and measured the distance of our line from the said Point, and found it was sixteen feet and nine inches to the Eastward of the s'd Point. . . .

November 13, 1764

. . . we computed how far the true Tangent Line would be distant from the Post (shewn us to be the Tangent Point) and found it would not pass one inch to the Westward or Eastward.

On measuring the angle of our last line, with the direction from Newcastle, it was so near a right angle that, on a mean from our Lines, the above mentioned Post is the true Tangent Point.

Cha : Mason,
Jere : Dixon.

In brief "the former Surveyors" had done a job in locating the Tangent Point that Mason and Dixon after five months of work could not improve upon. The writer is moved to say a word for the Provincial Surveyors who carried on from the early winter of 1760 until the early autumn of 1763. They brought to their work neither the training, nor the experience, nor the instruments, nor the volume of scientific and technological counsel that Mason and Dixon brought with them to Philadelphia in November, 1763. But they did bring to their work integrity, sound technological instincts, and a goodly measure of genuine competence, as their Field Books show. They carried on and they did achieve results that stood up under scrutiny.

The Provincials worked under a number of disadvantages. They were provincials; what could one expect of them? And they were selected in equal numbers from two rival provinces. Differences of opinion were to be expected and were sure to be exaggerated when they did appear. And the Provincials had the thankless job of first showing Frederick Lord Baltimore and his uncle Cecilius Calvert and Thomas and Richard Penn that the final survey was foredoomed to continue

[11] The original day by day record kept by Mason and Dixon is preserved in National Archives, Washington, D. C. Film copies can be secured.

for eight long years and to cost each Proprietary a snug fortune.

The bicentennial anniversary of the final survey of 1760–1768 will soon be with us. If any observance of this anniversary is contemplated, of course Charles Mason and Jeremiah Dixon will be recalled. Would it not be also appropriate to recall by name and record each of the Provincial Surveyors who carried on so bravely during its first three years?

Much attention has been given in this article to two familiar stars in our northern sky, Polaris at the tip of the handle of the Little Dipper and Alioth in the handle of the Big Dipper, the star nearest the bowl; all of this attention has been given because these two stars guided the surveyors northward up the Delmarva Peninsula and enabled them to lay out and to mark the meridian of the Middle Point; and this because during the current and recent centuries the pole of the heavens has been moving almost along the line which joins Alioth and Polaris and very close to Polaris.

Millennia ago the pole of the heavens was tracing its slow course far from Alioth and Polaris. But men then doing constructive work appear to have known where it was among the stars. It was claimed a century ago that the Pyramid of Cheops at Gizeh, Egypt, contains in its design evidence that the architects of that structure were guided by the pole which was then near a bright star in the head of the Dragon.[12] A recent writer on the Pyramids,[13] who questions many of the claims made by some astronomers of a century ago, still maintains that the orientation of the Pyramids at Gizeh is so consistent as to suggest that the architects who planned the structures were guided by the pole of the heavens as it was among the stars when the Pyramids were built.

[12] *Encyclopaedia Britannica,* The Pyramids; Sir John Herschel, Entrance passages in the Pyramids of Gizeh, *Phil. Mag.* 24, June, 1844; Sir John Herschel, *Outlines of astronomy,* 10th ed., 205–206, London, 1869.

[13] Lauer, J. P., Le problème des pyramides d'Egypte, quatrième partie, chap. II, Paris, Payot, 1948.