

"WESTWARD FIVE DEGREES IN LONGITUDE"

Thomas D. Cope

University of Pennsylvania

(This paper has been written with the aid of a grant made by the American Philosophical Society from its Penrose Fund. Copies of sources in England have been supplied by H. W. Robinson, Librarian of the Royal Society of London. Copies of material owned by the Royal Society were made by permission of the President and Council.)

The title is quoted from the Charter of Pennsylvania granted to William Penn by King Charles II on March 4, 1681. It defines the extent of the Province, and creates the problem of measuring five degrees of longitude westward from the Delaware River. In the days of William Penn, and for more than a century later, this was a problem that called for all that scientists and surveyors then had of knowledge and skills.

The first proposal to measure a degree of longitude in Pennsylvania is referred to in a letter preserved in the British Museum, written on February 24, 1764, by John Bird to the Secretary of the Royal Society, inquiring about a letter from Jeremiah Dixon written to Bird from Philadelphia. Bird had referred it to the Secretary. Dixon's letter was read to a Council of the Society on the 28th of the following June. It proposed that the Society sponsor the measuring of a degree of longitude upon a parallel at Philadelphia. On the 25th of October 1764, Thomas Penn offered to direct Mason and Dixon to make the measurement upon the parallel between Maryland and Pennsylvania without any expense to the Royal Society "if the Society would direct the method of doing it."

Mr. Penn was thanked warmly and a distinguished committee was named to draw up instructions and to decide what instruments would be necessary.

Nothing came of this first suggestion. But Charles Mason and Jeremiah Dixon were men not easily discouraged. During June 1765, they had a few (days of leisure at Newark in New Castle County on the Delaware while waiting for the provincial commissioners to assemble. They improved the time by writing a long letter to an old friend, the Rev. Nevil Maskelyne, their comrade in work at Greenwich, Cape of Good Hope and Saint Helena, who had just been named Astronomer Royal, the fifth director of Greenwich Observatory. They offered congratulations and outlined at length the opportunities at hand for measuring both a degree of latitude and a degree of longitude along the boundaries they were then surveying between the Lower Counties and Maryland, and between Maryland and Pennsylvania.

This letter brought results. Astronomer Royal Maskelyne read it to a Council of the Royal Society on October 17, 1765. It is spread verbatim upon five pages of the Minutes. Deliberations and reports upon it continued for many weeks. The Royal Society finally agreed to sponsor the measurement of a degree of latitude, appropriated funds to meet the cost, secured the cooperation of Lord Baltimore and Thomas Penn, provided equipment and supplies, and requested the

Astronomer Royal to direct the project. Benjamin Franklin, who was then in London, was consulted about conveyances and routes by which to send mail and equipment to Mason and Dixon in Pennsylvania.

A degree of latitude was measured for the Royal Society by Mason and Dixon during the winter and spring of 1766-1767 and during the first six months of 1768 along the courses from Harlan's Farm in Chester County, Pa., to the southwest corner of Delaware. This unusual scientific work in colonial Pennsylvania made a profound impression upon the quiet countryside. The tradition of it still lingers after one hundred and eighty years. The work was reported to the Royal Society by Mason and Dixon and Astronomer Royal Maskelyne. Full accounts appear in *Philosophical Transactions* for 1768.

Under orders from the provincial Commissioners Mason and Dixon surveyed the Parallel that separates Maryland from Pennsylvania eastward to the shore of the Delaware River in November, 1766. And during the summer and autumn of 1767, they extended it westward from the crest of the Alleghenies. Orders were to attain five degrees of longitude westward from the shore of the Delaware. Through this wild mountain country a delegation of Indians sent by the Six Nations served as escort. At the Indian War Path along Dunkard Creek in present day Greene County, Pa., the escort halted and refused to go beyond. The westward extension of the Parallel ended on Oct. 18, 1767, at a post on a mound on the summit of Brown's Hill west of the third crossing of Dunkard Creek. Mason and Dixon never measured a degree of longitude along the Parallel, or elsewhere.

Late in December 1767, the Commissioners and their Surveyors met at Christiana Bridge in New Castle County. The Commissioners record in their Minutes of Dec. 25 that the Parallel had been surveyed and marked 244 miles 38 chains and 36 links westward from the Delaware; that the Surveyors find, and the Commissioners agree, that five degrees along the Parallel extend 267 miles, 58 chains, and 90 links. This makes one degree on the Parallel equal to 53.547 miles. In their Diary, Mason and Dixon tell the story in the guarded language of scientists. On Dec. 26th, they say, the Commissioners asked for the length of a degree of longitude in the Parallel of the West Line. Two weeks later, on Jan. 8, 1768, the Diary records that the Commissioners were sent a tentative value of 53.5549 miles with a clear, concise statement of the assumption made in calculating it, ending with the words, "We do not give in this as accurate."

It is clear that the Parallel would have continued 23 and one-quarter miles beyond the post on Brown's Hill if the Indian Escort had not halted.

Five degrees of longitude westward from the Delaware River were established seventeen years after the survey of Mason and Dixon by commissioners and astronomer-surveyors representing Virginia and Pennsylvania. The two commonwealths had agreed that the southwest corner of Pennsylvania should be five degrees from the Delaware measured along the Parallel already established and marked in part by Mason and Dixon.

During the summer of 1784 eclipses of the satellites of Jupiter and other astronomical phenomena were systematically observed at two temporary observatories, one at Wilmington, Delaware, the other on a high hill just west of the spot soon found to be the southwest Corner. The Wilmington

Observatory was manned by Rev. Robert Andrews and John Page of Virginia and by Dr. David Rittenhouse and John Lukens of Pennsylvania. The western Station was occupied by Rev. James Madison and Andrew Ellicott of Virginia and by Provost the Rev. John Ewing and Thomas Hutchins of Pennsylvania.

Those are eight names to conjure with. Each station was equipped with the best timepieces, telescopes, and other instruments available. At each, precise local times of sharply defined events visible from both stations were recorded. At the end of the summer, Messrs. Rittenhouse and Andrews carried the Wilmington observations to the western station where a comparison showed that the two stations "were distant from each other twenty minutes and one second and one eighth part of a Second of Time." "A Squared White Oak Post" was set at the Corner, "one hundred and thirty-four chains and nine Links East of the Meridian of the western observatory."

It will be noted that the post at the Southwest Corner was located in 1784 primarily by astronomical methods. The length assumed for a degree of longitude by the surveyors when they made the final corrections had only a trifling effect upon its position.

A century later, during the 1880's West Virginia and Pennsylvania resurveyed their common boundaries. On February 9, 1884, C. H. Van Orden of the U.S. Coast and Geodetic Survey reported to the Commissioners of the two states that he found the mound on Brown's Hill to be 21.163 miles east of the monument at the Southwest Corner. The commissioners and surveyors of 1767 would have made the distance 23 and one-quarter miles.

Five degrees of longitude along Mason and Dixon's Parallel (Latitude $39^{\circ}43'18''$) I calculate from data in the Smithsonian Geographical Tables to be 266.390 miles. This, within a few feet, is the distance from the shore of the Delaware to the monument at the Southwest Corner of Pennsylvania.

It is shorter than the commissioners and surveyors of 1767 would have made the distance by one and one-third miles.

It is longer than the measure of Mason and Dixon from the Delaware to Brown's Hill plus Van Orden's measure from Brown's Hill to the Corner by three quarters of a mile.

The Survey of 1767 assumed the length of a degree of longitude to be known. Mason and Dixon knew it to be uncertain. They had asked for a chance to make an independent determination of a degree. Then the Survey was measuring off supposed degrees, end to end against time, across wild, rough mountains, through Indian country during the anxious days of 1767. Let's credit the Indian Escort with an unintended service when it halted the undertaking at Dunkard Creek.

A curiosity about recent determinations of the difference in longitude between the western shore of the Delaware and the monument at the Southwestern Corner of Pennsylvania has led the writer to inquire of the acting Director of the U.S. Coast and Geodetic Survey. This gentleman has

kindly replied that the horizontal control network has not yet reached the Southwest Corner. It has, however, included two other monuments on the West Virginia-Pennsylvania boundary. The difference in longitude between one of these and the Corner was determined in 1883. The longitude of the eastern end of the Parallel, the Acting Director scaled from an official map. The writer has put all the information together and finds that the Southwest Corner lies five degrees plus 23 feet west of the Delaware shore.

In short, the astronomer-surveyors of Virginia and Pennsylvania did a masterly job of pioneer geodetic surveying during the summer of 1784. They went into the field determined to do a piece of work that would stand. They insisted upon working conditions that would permit such work to be done. And while in the field they took the time needed for work of the highest order. In the spring of 1784, arrangements for their compensation and maintenance while in the field were not yet satisfactory to the astronomer-surveyors of Pennsylvania. Their words are worth quoting.

"And when we reflect upon the accuracy necessary . . . and above all the Regard we ought to have to our characters with all the Gentlemen of Astronomical Knowledge in Europe, whose Eyes will be turned upon us, and who will expect from us all that Precision, that can be derived from the greatest astronomi-cal Discoveries that have yet been made; We expect that the supreme Executive Council . . ."

The foregoing was written by Messrs. Ewing, Rittenhouse, Lukens, and Hutchins to His Excellency John Dickinson, Esq., President of the State, on March 30, 1784.

And, one week later Messrs. Ewing, Rittenhouse, and Hutchins joined in telling The Supreme Executive Council of Pennsylvania,

"An anxious desire to gratify the astronomical World in the performance of a Problem which has never yet been attempted in any Country, by a Precision and accuracy that would do no Dishonour to our Characters . . . has induced us to suffer our names to be mentioned . . ."

Their demands were met in full. Even in those old days, the scientists of Pennsylvania knew how to talk to officials of government.

SOURCES OF MATERIAL

Letter of John Bird to Rev. Thomas Birch, February 24, 1764. Original in British Museum. Copy in Library of American Philosophical Society.

Minutes of Councils of the Royal Society, London, England. Photographic copies of minutes during 1760-1768 in Library of American Philosophical Society, Philadelphia, Pa.

Charles Mason's Daily Journal 1761-1768, National Archives, Washington, D. C. Photographic copy in Library of the American Philosophical Society.

Minutes of the Commissioners representing Maryland and Pennsylvania, 1761-1768. Original in the Land Office, Hall of Records, Annapolis, Md. Copies in Library of American Philosophical Society.

Surveys and Re-Surveys of the Boundary Lines of the Commonwealth, pp.282-328, especially pp. 3~328. The Secretary of Internal Affairs of Pennsylvania, Harrisburg, 1887.

Correspondence of the writer with the Acting Director of the U. S. Coast and Geodetic Survey. 1948.