Charles Mason And Jeremiah Dixon

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"STARGAZER" has a special meaning in Chester County, Pa., though it is now nearly 200 years since Charles Mason and Jeremiah Dixon came from England to set up their surveying instruments on the farm of John Harlan in Newlin Township. For the tradition persists among Harlan's descendants, who still own and cultivate the farm, and among the descendants of men who worked for Mason and Dixon that these two were unusual individuals who worked with remarkable instruments and spent much time mysteriously observing the stars. Except in this community, however, and to a few astronomers, geodesists, and perhaps a chance historian, the men Mason and Dixon are shadowy figures or "just surveyors."

Charles Mason laid the foundation of his career at Greenwich where he worked from 1756 to 1760 as assistant observer to the Reverend James Bradley, Astronomer Royal. Bradley was then near the end of his career (he died in 1762). As a young man he had discovered the aberration of light and the nutation of the axis of the Earth and had founded a new era of precise observations. He had enlarged the Greenwich Observatory and equipped it with new instruments. Mason acquired some of the spirit and the ideals of his preceptor and learned from him the use of instruments of precision and the art of observing. At Greenwich Mason made the acquaintance of the Reverend Nevil Maskelyne, a young astronomer who was assisting the Astronomer Royal in a study of atmospheric refraction. This association of Mason and Maskelyne continued as long as Mason lived.

And at Greenwich Mason first learned to know Mayer's *Tables of the Moon.* Early in 1755 Professor Tobias Mayer of Göttingen University had filed a claim with the Lords of the British Admiralty for one of the awards promised by act of Parliament of the fourteenth year of Queen Anne to discoverers of improvements in ways of finding the longitude at sea. In support of his claim Mayer had submitted in manuscript a new set of lunar tables with accompanying theory and other papers. In due course the Admiralty referred these claims and exhibits to the Astronomer Royal for investigation and report.

Bradley first reported on Mayer's *Tables* on February 10, 1756, and finally on April 14, 1760. With the assistance of Charles Mason, Bradley had compared positions of the Moon as predicted in the *Tables* with positions as observed at Greenwich. Eleven hundred comparisons led to the comment:

> So far as it will depend upon the lunar tables the true longitude of a ship at sea may in all cases be found within about half a degree and generally much nearer.
>
> It remained to be examined within what limits the errors arising from observations actually taken at sea could be contained.

This test was carried out for Bradley by Captain Campbell, of *H.M.S. Royal George,* on cruises near Ushant in 1758 and 1759. A sextant was made especially for the trials by John Bird, instrument maker for Greenwich Observatory. Bradley's final comment reads:

> However great the difficulties of finding the longitude by this method seem to be, they are not insuperable, or such as ought to deter those whom it most nearly concerns from attempting to remove them.

James Bradley was now nearing the end of his days. His hand was faltering.

Nevil Maskelyne and Charles Mason received the torch he had carried. They made the development of the method of lunar distances for finding the longitude at sea a major concern of the rest of their lives.

A transit of Venus across the face of the Sun was due to occur on June 5, 1761. It would afford a golden opportunity to determine the distance from Earth to Sun. To secure data observers would need to be stationed at strategic posts over the face of the Earth. The equipment needed would be simple—telescopes, timepieces, and instruments for measuring small angles.

Early in 1760 the Royal Society of London drew up plans to observe the transit at home and to send expeditions abroad, one to St. Helena where the end of the transit could be observed, the other to Sumatra where the whole phenomenon could be seen. Nevil Maskelyne was chosen to go to St. Helena, assisted by Robert Waddington; Charles Mason was selected to go to Sumatra with Jeremiah Dixon as assistant. Dixon was a surveyor and amateur astronomer from Cockfield in the county of Durham.

Both expeditions sailed from England as the year changed from 1760 to 1761. Mason and Dixon were carried by *H.M.S. Seahorse*. An engagement with a French man-of-war and accidents of wind and weather delayed their progress. They were obliged to disembark at the Cape of Good Hope and observe the end of the transit there. It occurred just after sunrise on June 5; weather was excellent.

Observations were reported by 176 observers from 117 stations. Perhaps the best commentary upon the work of Mason and Dixon on this occasion was written 130 years later. In 1891 the late Professor Simon Newcomb of the United States Naval Observatory published an exhaustive review of the transits of Venus of 1761 and 1769. To the observations made by Mason and Dixon at the Cape of Good Hope in 1761 he assigned weights that were among the very highest that he allotted.

In the early autumn of 1761 Mason and Dixon sailed from the Cape of Good Hope to St. Helena and joined Maskelyne and Waddington in a program of research that continued into 1762. Maskelyne had with him an astronomical clock made for the Royal Society by John Shelton. This clock is still in the possession of the Society and has been used on expeditions to many regions. Bradley had adjusted the clock at Greenwich and had found its rate of losing time when compared with the stars. Maskelyne had set it up on St. Helena with its pendulum at the same length and had found its rate there. Soon after his arrival at St. Helena, Dixon was sent with the clock back to the Cape of Good Hope for a similar determination.

The rates of a pendulum of constant length at various stations give relative values of gravity at these stations. They in turn permit inferences about the relative lengths of the polar and equatorial diameters of the Earth. Since Maskelyne was interested in the size and shape of the Earth, he continued to make determinations of gravity with John Shelton's clock. He took it to the Barbados during 1763 and 1764. In 1766 he sent it to Mason and Dixon in Pennsylvania, where they observed with it on Harlan's Farm.

Since at St. Helena the star Sirius in its diurnal motion passes near the zenith, its zenith distance as it crosses the meridian can be measured with precision. On account of its brightness Sirius was regarded as one of the nearest stars, probably with a large annual parallax. If this assumption were correct the zenith distance should change materially with the motion of the Earth in its orbit over a period of months. Maskelyne went to St. Helena prepared to measure the zenith distances of Sirius with a new zenith sector built for the Royal Society by Jonathan Sisson. (A zenith sector is a graduated arc of a vertical circle provided with a telescope and plumb line.)

Maskelyne soon found that the manner of suspending the plumb line introduced serious errors into the readings. After his return to England he demonstrated to a committee of the Royal Society that the fault existed and that it had probably affected all zenith sectors previously built. The first sector free of this defect was built at once for Thomas and Richard Penn by John Bird and in the autumn of 1763 was brought to Philadelphia by Mason and Dixon. It was used by them in every determination of latitude they made in America.

His voyages to St. Helena and back to England and the voyage to the Barbados permitted Nevil Maskelyne to test the method of lunar distances and Mayer's *Lunar Tables* in finding the longitude of his ship. The outcomes were so encouraging as to lead Maskelyne to embody the method in a booklet for navigators that he published in 1763, *The British Mariner's Guide*.

James Bradley's successor as Astronomer Royal was Nathaniel Bliss, who lived only two years after his appointment. Maskelyne succeeded him early in 1765 and thus became the fifth Astronomer Royal at Greenwich.

In the meantime, on July 4, 1760, while the Royal Society was planning to observe the coming transit of Venus, the Proprietors of Maryland and Pennsylvania had entered into an agreement before the Court of Chancery to end their differences and forthwith to survey and mark their common boundaries. Both parties appointed commissioners from the provinces to carry out the articles of agreement. They in turn met at New Castle on the Delaware, agreed upon procedures, and engaged surveyors from Maryland and Pennsylvania.

The Middle Point of the peninsula between Delaware and Chesapeake bays had been determined, accepted, and marked in 1751. It is now the southwestern corner of Delaware. The eastern boundary of Maryland northward from the Middle Point to the Pennsylvania border was still to be surveyed. It was agreed upon as a straight line northward up the peninsula from the Middle Point until it made a tangent to the periphery of a circle of 12 miles radius drawn around New Castle. From the Tangent Point northward the boundary should consist, first, of that part of the circular arc that might lie westward of the meridian through the Tangent Point, and thence northward the meridian of the Tangent Point to an east-west line 15 miles south of the southernmost point of the city of Philadelphia. Except for slight errors made in surveying this describes the boundary as it stands today.

The provincial surveyors struggled to establish the Tangent Line from the spring of 1761 until the autumn of 1763. They ran a meridian northward from the Middle Point until the spire of the Court House in New Castle was in sight. Then they ran a radius out from the spire to intersect the meridian, measured distances and angles, calculated the position of the Tangent Point and the bearing of the Tangent Line. They set posts to mark the Tangent Point. Then they returned to the Middle Point and proceeded to lay off the Tangent Line. It fell half a mile to the east of the Tangent Point; a second trial ran 350 feet to the west.

The Proprietors were being kept informed of the progress of the survey. Both consulted Dr. John Bevis, and Thomas Penn sought advice from Dr. John Robertson, Master of the Royal Naval Academy at Portsmouth. Jonathan Sisson and John Bird were engaged to construct surveying equipment. As

months grew into years and as expenses mounted, the Proprietors became impatient.

Just who introduced Mason and Dixon to Thomas Penn is not clear. On June 18, 1763, however, Penn wrote to the Commissioners for Pennsylvania:

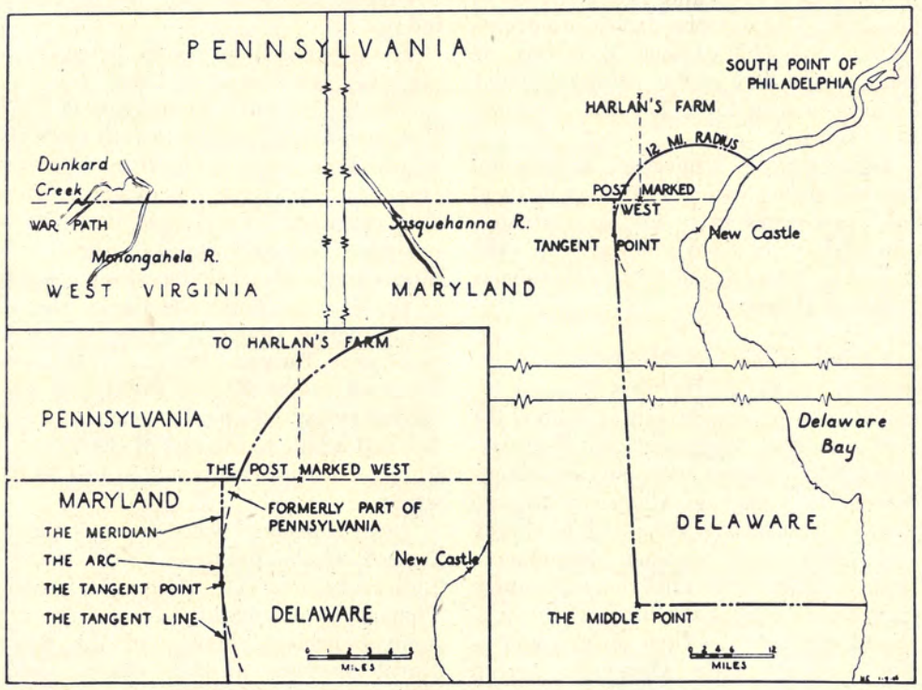
> We intended to persuade Lord Baltimore to join in sending some very able Surveyors that were skillful in making Celestial observations from hence, to this proposal we never got any consent of his till two Days since, . . . and Mr. Calvert joined with us in desiring the mathematicians, we proposed, to come to London, as soon as possible.

On August 10, 1763, he wrote to the provincial secretary, the Reverend Richard Peters:

> Mr. Mason and Mr. Dixon have taken their passages with Captain Falconar . . . and they have with them the fine Sector, two Transit Instruments, and two reflecting Telescopes, fit to look at the Posts in the Line for ten or twelve miles.

They carried also *Hints for Running the Lines* that had been prepared by John Bevis and Daniel Harris. The latter had succeeded John Robertson as mathematical master at Christ's Hospital.

Mason and Dixon arrived at Philadelphia on November 15, brought their instruments ashore, met the commissioners of both provinces, and took oaths to undertake the survey. With the aid of city authorities they selected the South Point of Philadelphia, erected a temporary observatory near it, set up John Bird's zenith sector, and measured the zenith distances of eight stars of Bradley's *Catalogue* as they passed the meridian. Apparent distances were corrected for refraction and were reduced for precession, aberration, and nutation to January 1, 1764. The latitude of the south point of Philadelphia as given by



IMPORTANT POINTS OF MASON AND DIXON'S SURVEYS

Photo by J. Carroll Hayes

THE HARLAN HOMESTEAD

IN JANUARY 1764 MASON AND DIXON MOVED TO THIS FARM WHICH BECAME THEIR HEADQUARTERS.

stars taken from Bradley's *Catalogue* was 39° 56′ 29.1″. Modern determinations make it only 2.5″ less.

In January 1764, the surveyors moved westward 31 miles to John Harlan's Farm, which became their headquarters. The observatory was erected, and the latitude was found. When the season opened, they moved southward from Harlan's along a meridian. Distances were measured as they proceeded, on level ground by chain, on slopes by levels. Again the latitude was determined, and a post marked "West" was set up in a field of Alexander Bryan's farm in New Castle County to mark the latitude 15 miles south of the South Point of Philadelphia. This post became the reference point for the parallel of latitude that separates Pennsylvania from Maryland.

For the next 4 years the survey proceeded. Vistas were opened through the forest, the Tangent Line was run, and the position of the Tangent Point was confirmed as marked. Northward, one mile and a half of circular arc and three miles and a half of meridian completed the eastern boundary of Maryland to the northeastern corner of the state in latitude 15 miles south of the South Point of Philadelphia.

The Parallel that separates Maryland and West Virginia from Pennsylvania was surveyed from the Delaware River to Dunkard Creek in the west. Agreement provided that it should span 5 degrees of longitude, but conditions in the Indian country halted its westward extension. The Five Nations provided an escort from the crest of the Alleghenies westward during the summer of 1767, but the escort refused to cross an Indian line west of the Monongahela River.

The Parallel was established step by step. Arcs of great circles were calculated to intersect the Parallel 10 minutes to the west. The arcs were run by transit. Then latitude was found by the zenith sector; offsets to the Parallel were calculated, and the Parallel was marked.

Historical Society of Delaware

THE TANGENT STONE

FROM THE DELAWARE SIDE. THE NEWER STONE WAS ERECTED IN 1849 NEXT TO THE ORIGINAL.

Vistas were opened along all lines. In the mountains to the west the Parallel was marked by cairns on the ridges; to the eastward the boundaries were marked by limestone monuments brought from England. Many of these markers are standing to this day.

On January 29, 1768, Mason and Dixon handed the map of the boundary to the commissioners.

MASON and Dixon spent five winters in America. The two winters following that of 1763–64 took them on excursions into neighboring colonies. The winters of 1766–67 and 1767–68 were spent at Harlan's Farm in scientific work for the Royal Society. Both men were acquainted with geodetic and geophysical measurements that had been made in Europe and on other continents. They themselves had used John Shelton's clock for determinations of gravity on St. Helena and at the Cape of Good Hope. They knew that in 1752 the Abbe de la Caille had measured an arc of meridian at the Cape and from it had calculated the length of a degree of latitude in that region of the Earth. In the same year the Jesuit astronomers Boscovich and Le Maire (the latter was from the same county in England as Jeremiah Dixon) had measured an arc of meridian across the Apennines from Rome to Rimini. For generations members of the French Academy had been measuring meridians in France, in Lapland, and in Peru. And in 1761 Cassini de Thury had begun to extend a parallel of latitude from Brest to Vienna. These projects had contributed data from which the size and shape of the Earth had been inferred, especially the flattening at the poles and the bulge at the equator.

No data had as yet been obtained from North America. In 1760 Father Roger Joseph Boscovich visited London. He was well received and was elected a fellow of the Royal Society. The record shows that he proposed to the Society that it measure a degree of latitude in America.

Before they had been long in America Mason and Dixon acquainted the Royal Society with the opportunities that were at hand along the Maryland-Pennsylvania boundary for measuring a degree of latitude and a degree of longitude. Their proposal was conveyed to the Council of the Society by Nevil Maskelyne. It received favorable attention on October 24, 1765. The project of measuring a degree of latitude was sponsored, funds were appropriated, instruments were supplied, the acquiescence of Lord Baltimore and the brothers Penn was sought, and the use of their instruments was bespoken.

Both the secretary of the Royal Society and the Astronomer Royal sent word of these decisions promptly. The latter drew up a letter of advice and instructions and forwarded it early in Novem-

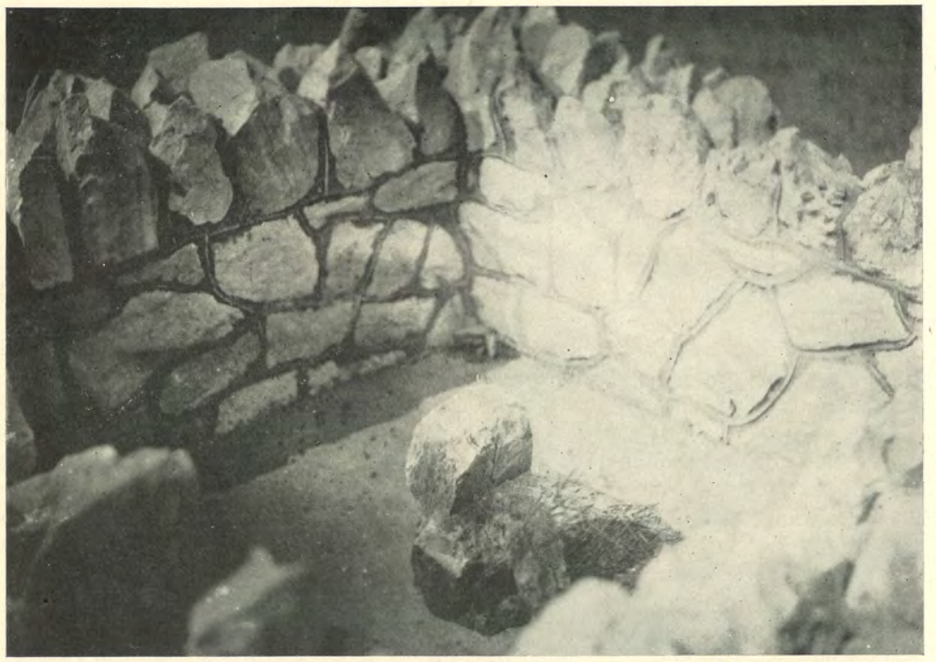


Photo by C. H. Thomas

THE STARGAZERS' STONE

THIS MARKER, NOW PROTECTED BY A STONE WALL, WAS SET BY MASON AND DIXON ON MARCH 5, 1764.

ber 1765. Mason and Dixon were instructed to measure again the courses that linked the site of the observatory at Harlan's with the Middle Point. Both lengths and bearings were to be redetermined with all attainable precision. The latitude of the Middle Point was to be found and that of the site at Harlan's found again. To improve precision a 5-foot brass rod and 20-foot fir rods with brass ends, made by John Bird, were provided. Besides, there were sent a spirit level, silver wire for supporting plumb bobs, thermometers, and John Shelton's clock. Detailed instructions accompanied the instruments.

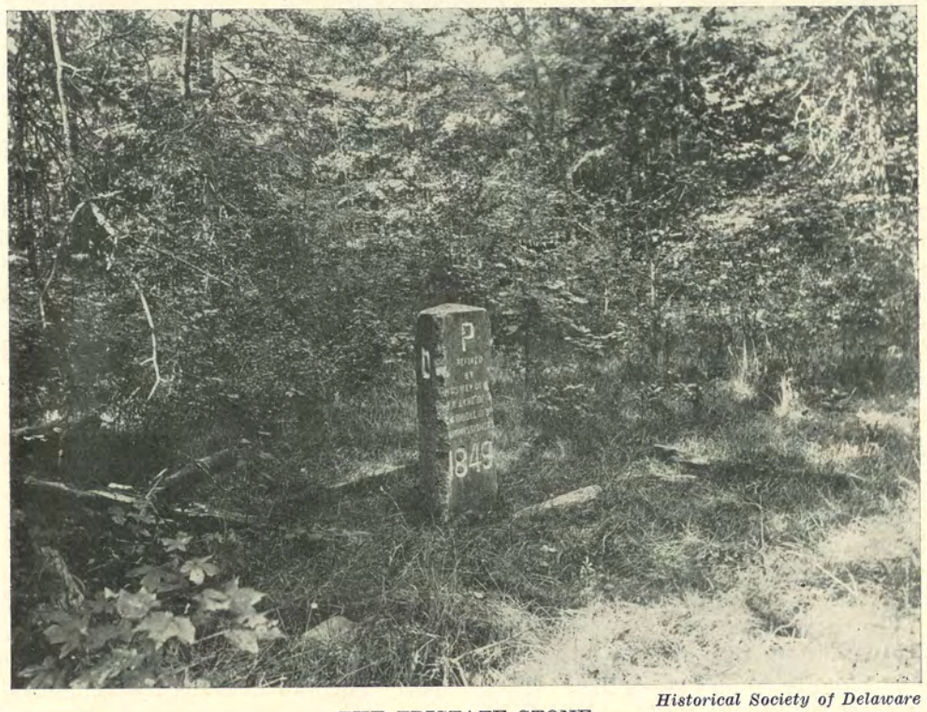
The first opportunity to work on the projects of the Royal Society came to Mason and Dixon in October 1766. They had just returned to the Maryland-Delaware peninsula from the Alleghenies, where they had spent the season extending the Parallel of Latitude westward. All work planned for the year had been completed except that of setting markers along the Tangent Line. On October 8 they arrived at the Middle Point and there spent 11 days in finding the latitude. The zenith distances of ten of Bradley's stars were measured repeatedly as they crossed the meridian. Corrections for refraction were made, and reductions for precession, aberration, and nutation.

In 1764 two courses had been run from the Middle Point toward the Tangent Point, one slightly to the west of it, the other to the east. The bearing of the former course was now remeasured at the Middle Point. The party then moved slowly northward along the boundary, checked bearings, measured offsets to the Tangent Line, and set permanent markers. From November 18 to 21 they

met with the Commissioners at Christiana Bridge, New Castle County, and were there instructed to extend the Parallel eastward to the Delaware River. This was completed by December 1.

The party then moved northward again and on December 5 established itself for the winter at Harlan's Farm. The zenith sector was set up just where it had stood 3 years earlier. Two astronomical clocks were mounted. One belonged to the Penns; the other was John Shelton's clock. The party remained at Harlan's until the middle of June 1767. The latitude was found with great precision. Eclipses of Jupiter's moons were observed to establish the longitude of the station. The pendulum of Shelton's clock was adjusted to the length prescribed by the Astronomer Royal, and by comparison with the stars its rate was found. Amplitude of swing and temperatures were recorded systematically. On May 24 there came a copy of the first issue of the *Nautical Almanac,* that for the year 1767, and a letter from the Astronomer Royal asking for a report of progress and directing that Shelton's clock be sent home at once, in order that it might be made ready for use in observing another transit of Venus expected to occur in June 1769.

The Parallel of Latitude was extended to its farthest west during the summer and autumn of 1767. The final report of the survey was handed to the Proprietors during January 1768. Mason and Dixon were then free to complete their projects for the Royal Society. They returned to Harlan's Farm on February 1 and at



Historical Society of Delaware

THE TRISTATE STONE

SET IN 1849 TO REPLACE A STONE ERECTED IN THE ORIGINAL MASON AND DIXON SURVEY AT THE TIP OF THE WEDGE (SEE MAP), WHICH WAS THEN REGARDED AS THE SOUTHERNMOST POINT OF PENNSYLVANIA.

once made ready to measure the courses that extended southward from that station to the Middle Point.

Levels had to be constructed. Joel Bailey, a local surveyor who had helped with the survey, was engaged to build sturdy frames of pine to carry the 20-foot brass-tipped fir rods. Each frame had a plumb line hanging in a tube at its middle. A frame was set up with its rod horizontal in the line being measured. Its position was marked to the hundredth of an inch on a stake set at the bottom of the plumb bob. The next frame was set in line with the rods end to end as shown by a plumb line. Temperatures were recorded. The rods were checked regularly against the Royal Society's 5-foot brass standard of length.

With all attention to detail the levels were applied first to the course 15 miles due south from the observatory at Harlan's to the Parallel. Then a shift of almost 3 miles due west placed them in the meridian of the Tangent Point. The levels were applied to this meridian until the Tangent Point was reached. Then the levels were carried westward and 90 feet southward to the arc of a great circle first run in 1764 and checked two years later. Thence a steady, patient march of almost 82 miles brought men and levels to the Middle Point on June 6.

Mason and Dixon returned to Harlan's Farm on June 16 and said farewell to it two weeks later. They settled accounts with the Commissioners during August and sailed from New York for England on September 11. "Thus ends my restless progress in America," wrote Mason at the end of their *Diary*.

From the data, Nevil Maskelyne found that the Middle Point lay south of the observatory at Harlan's 1° 8′ 45″ by celestial observations and 538,067 feet as measured horizontally over ground. Hence "363,763 English feet is the length of a degree of latitude in the provinces of Pennsylvania and Maryland." He analyzed the work and incorporated the result in a table of degrees of latitude that had been measured in Europe, South Africa, and South America between 1736 and 1768. (Immediately after its announcement Honorable Henry Cavendish pointed out that the Atlantic Ocean and the Alleghenies had probably deflected the plumb line of the zenith sector to an appreciable extent for which no correction could be made.)

Delaware Board of Agriculture

THE MIDDLE POINT

BETWEEN THE CHESAPEAKE BAY AND THE OCEAN.

Philadelphia in those days was the second city of the British Empire, and among its inhabitants was a coterie of men who were keenly appreciative of scientific progress. Charles Mason, Jeremiah Dixon, Nevil Maskelyne, and Joel Bailey were soon elected to the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge.

For the guidance of observers of the transit of Venus which was to occur on June 3, 1769, Astronomer Royal Maskelyne published instructions as a supple-

Delaware Board of Agriculture

THE COURTHOUSE AT NEW CASTLE, DEL.

THIS WAS THE ORIGINAL CENTER OF THE ARC OF 12 MILES' RADIUS FORMING THE DEL.-PA. BOUNDARY.

ment to the *Nautical Almanac*. The Royal Society prepared to observe the transit at home and to send expeditions abroad. Western Europe was to see the transit begin before sunset; eastern North America would see its early stages during the afternoon; western North America, Alaska, and the Arctic regions would see the entire transit; and Australia, Asia, and eastern Europe would see its end after sunrise.

Astronomers of the American Philosophical Society established temporary observatories for viewing the transit on State House Square in Philadelphia, at Norriton, Pa., and at Lewes, Del. They made admirable records of the transit and sent them to the Royal Society. The Royal Society sent William Wales and Joseph Dymond to Prince of Wales Fort on Hudson Bay. They saw the entire transit from ingress to external contact at egress with highly favorable weather throughout. To observe the transit in the Pacific, the Society sent Lieutenant James Cook on the first of his famous voyages. His ship, the *Endeavour,* carried a distinguished company which included astronomer Charles Green and naturalist Joseph Banks. They observed the transit from Tahiti. "There not being a cloud in the sky from the rising to the setting of the Sun, the whole passage of the planet Venus over the Sun's disk was observed with great advantage."

Jeremiah Dixon and W. Bayley were sent to North Cape, Norway. Weather was unfavorable, and their observations were fragmentary. Charles Mason proceeded to Cavan, near Strabane, in county Donegal, Ireland, established an observatory, and made records for the Royal Society from April 3 to November 28, 1769. His report on time, latitude, and longitude is a masterly one. He made complete records of the beginning of the transit.

Years later the astronomer Encke studied and restudied the data secured in 1761 and 1769. In 1835 he announced the conclusion that the Earth is 95,370,000 miles from the Sun, a distance accepted as correct for the next 30 years.

Sir Isaac Newton had predicted that a "hemispherical mountain 3 miles high and 6 miles broad will not by its attraction draw the plumb line 2 minutes out of the perpendicular." In 1738 members of the French Academy had tried to measure the attraction of Chimborazo in South America, with inconclusive results. Bouguer, who reported the attempt, proposed that a similar experiment be tried in France or England. In 1772 Maskelyne proposed to the Royal Society that "the Attraction of some Hill in this Kingdom be measured by Astronomical Observations." The proposal was approved, and in 1773 Charles Mason was sent north to find a hill "of sufficient height tolerably well detached from other hills, and considerably larger from East to West than from North to South." He chose Schehallien in Perthshire, Scotland.

Maskelyne established an observatory on the south face of Schehallien in the early summer of 1774. He set up Jonathan Sisson's zenith sector and measured the zenith distances of stars in Mason's table as they passed the meridian. Then his instrument was carried over the mountain to its north face where similar observations were made of the same stars. The differences made it appear that the instrument had been moved 54.6 seconds of arc northward. The difference in latitude was independently found by two triangulation surveys from

U. S. Coast and Geodetic Survey

GRANITE MONUMENT NO. 222

ERECTED IN 1865 BY SINCLAIR TO MARK THE NORTH WEST CORNER OF MARYLAND. PHOTO TAKEN IN 1900.

two carefully measured base lines on the plain below the mountain. Both agreed in placing the second station 42.94 seconds of arc north of the first.

The difference—54.6 less 42.94, or 11.66 seconds—was attributed to the deflection of the plumb line of the zenith sector by the mountain. During the triangulation the dimensions of the mountain were measured, its rocks were surveyed, and its mean density was estimated. The deflection of the plumb line permitted an estimate to be made of the mean density of the Earth. In this project instruments were used that have been met before: Sisson's zenith sector; John Shelton's clock; and the Royal Society's 5-foot brass standard.

THE last quarter of Charles Mason's life was spent on projects that grew out of his earlier work at Greenwich Observatory as assistant observer to Astronomer Royal Bradley. From studies of Bradley's records Mason prepared tables for the *Nautical Almanac* and he was able to improve Mayer's *Tables of the Moon* by comparing them with the Greenwich records.

The *Nautical Almanac* was established by Nevil Maskelyne in 1767, immediately after his appointment as Astronomer Royal, and it has appeared annually ever since. In the first issue the latitude and longitude of Cape Town are given as found by Mason and Dixon in 1761. The comment follows that "it is probable that the Situation of few Places is better determined."

To the *Almanac* for 1773 Mason contributed a catalogue of stars. The preface, written by Maskelyne, states:

> To this Ephemeris are annexed . . . a Catalogue of 387 fixed Stars . . . adapted to the beginning of the year 1760 . . . calculated from the late Dr. Bradley's Observations by Mr. Charles Mason, formerly his Assistant. . . . After the Catalogue follow some Memoranda . . . communicated by the same Mr. Mason.

The issue for 1774 first introduces Mason's improvements of Mayer's *Lunar Tables.* The preface written by Maskelyne on July 2, 1772, states:

> To this Ephemeris are annexed 1220 Longitudes and Latitudes of the Moon deduced from the late Dr. Bradley's Observations. . . . The greater part of these calculations were made during Dr. Bradley's Lifetime by himself and his Assistant Mr. Charles Mason; and what was left unfinished has been completed by Mr. Mason since at the Instance and at the Expence of the Board of Longitude.
>
> A Series of Observations this for Number and Exactness far excelling anything of the same kind which the World ever saw before. . . .
>
> Accordingly the Board of Longitude have thought proper to employ Mr. Mason farther in making the necessary calculations for improving Mayer's printed Tables under my Direction. . . .

The introductory pages of the *Almanac* for 1776 include a digest of legislation of the fourteenth year of King George III which had become effective on June 24, 1774. Rewards were set for timepieces, lunar tables, and other aids to navigation and finding the longitude.

References to new work by Mason appear in the prefaces to the *Nautical Almanac* for 1777 and for 1788. Finally, in the preface to the *Almanac* for 1798, which he signed on December 2, 1791, Maskelyne summarizes Mason's work on the Moon's position:

> The Moon's Place in the Heavens was inserted as calculated directly from Mayer's *Tables* in the *Nautical Almanac* from 1767 to 1776 inclusive, or the first ten years,
>
> But from the *Nautical Almanac* of 1777 to that of 1788, both inclusive, or the next twelve years, the Moon's Place was inserted as calculated from new *Tables,* improved from Mayer's *Tables,* composed by Mr. Charles Mason. . . .
>
> But from the *Nautical Almanac* of 1789 to 1796, both inclusive, the Moon's Place was inserted as calculated from new *Tables,* still further corrected by Mr. Mason, entitled by him the *Tables of 1780,* as having been completed about that time. . . .

Maskelyne then proposes small corrections to Mason's *Tables.*

February 9, 1765, is a cardinal date in the story of Mayer's *Tables,* for on that day Astronomer Royal Maskelyne laid before the Commissioners of Longitude reports of his own success in using the *Tables* for finding the longitude on his recent voyages to St. Helena and to the Barbados and also reports from masters and mates of ships of the East India Company. Upon hearing the evidence the Commissioners adopted resolutions to print Mayer's *Lunar Tables,* to seek authority from Parliament to establish a *Nautical Almanac,* and to pay to the widow of Mayer (for he had died in 1762) a sum not to exceed £5,000. The widow Mayer was granted £3,000. The *Tables* were published in 1770, and Maskelyne signed the preface to them on February 23 of that year.

Mason's tables of 1780 were published by the Commissioners of Longitude in 1787 under the title *Mayer's Lunar Tables improved by Mr. Charles Mason.* Mason never saw them in print. At the close of the eighteenth century Mason's were the most esteemed tables of the Moon. They were used in preparing *The Nautical Almanac* and in computing *La Connaissance des Temps.*

James Bradley had not published his Greenwich observations. In law they proved to be his personal property, and after his death they were claimed successfully by his only child, a daughter, and her husband, the Reverend Samuel Peach. They in turn gave the records to Oxford University where Bradley had studied and had held the Savilian professorship of Astronomy. The first of Bradley's records to be published was the catalogue of stars that Mason prepared for the *Nautical Almanac* of 1773. The Clarendon Press of Oxford University undertook the publication of all the records. The first volume appeared in 1798 under the editorship of Professor Thomas Hornsby. It includes Mason's star catalogue. Mason and Hornsby carried on an extensive correspondence about the Greenwich records that undoubtedly aided in preparing them for the press. The second volume, edited by Dr. Abram Robertson, appeared in 1805. Finally in 1832 there was published *The Miscellaneous Works and Correspondence of Reverend James Bradley* under the editorship of Professor S. P. Rigaud.

Jeremiah Dixon was made a fellow of the Royal Society on November 18, 1773. Little appears to be known of his remaining years. A bachelor, he died at his birthplace in Cockfield, Durham County, in 1779, where his father owned and operated a coal mine. Descendants of his brother have attained distinction as engineers and as amateur astronomers.

After long years the Commissioners granted Charles Mason £750 for his services to navigation in improving Mayer's *Tables;* his annual pay had been meager. On September 27, 1786, he wrote to Benjamin Franklin that he had just arrived in Philadelphia with a wife, seven sons, and a daughter, all in helpless condition; that he was ill and confined to his bed. It is not known what had brought him to America again; it is possible that it was the opening of the public land survey in eastern Ohio. With his letter to Franklin he enclosed a sketch of an astronomical project that would involve little expense.

Early in November 1786 Philadelphia newspapers announced that Mason had died there on October 25, and that while ill he had given his manuscripts and scientific papers to the Reverend John Ewing, provost of the University of Pennsylvania. Mason had known Ewing as a mathematician and astronomer of his own age who had served as a commissioner for Pennsylvania during the survey of the boundaries. No trace of the manuscripts and papers or of the astronomical project has been found.

Nevil Maskelyne long outlived his two contemporaries. He died with the harness on his back at Greenwich Observatory in 1811, at the age of seventy-nine.

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