

WHEN THE MARYLAND-PENNSYLVANIA BOUNDARY SURVEY CHANGED FROM
A POLITICAL AND LEGAL STRUGGLE INTO A SCIENTIFIC
AND TECHNOLOGICAL PROJECT¹

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THE quarrel over boundaries between the Baltimores and the Penns began in 1680 when William Penn petitioned King Charles II for a grant of land lying north of Maryland. Fifty-two years later the contending parties had agreed upon common boundaries substantially as they lie today, and on May 10, 1732, Charles Lord Baltimore and John, Thomas, and Richard Penn, sons and heirs of William Penn, signed articles of agreement to lay out and mark the boundaries as agreed upon. Benjamin Franklin, an alert young printer of Philadelphia, printed the Articles of Agreement in 1733 at the New Printing Office near Market. The American Philosophical Society and the Historical Society of Pennsylvania own two of the surviving copies.

A map was attached to the agreement of May, 1732, and it was held in such esteem by the Baltimores and the Penns that the same map was attached again to the final agreement over boundaries which a later Baltimore and Thomas and

Richard Penn signed before Chancery on July 4, 1760. Numerous copies of this map are owned by the Maryland Historical Society. It is reproduced in *Pennsylvania Archives*.² The map shows Delaware and Chesapeake Bays, the peninsula that lies between them, and all boundary lines on the peninsula. It shows also the lands to the north of the bays and a considerable extent of the Maryland-Pennsylvania boundary to the westward. It is described in the agreement as "a true copy of those which have been sent over from America to the present partys hereto by their respective agents in those parts. . . ."

The map was the work of John Senex, bookseller, cartographer, and globe-maker at the Globe in Salisbury Court, Fleet Street, London. Before Chancery, Ferdinando John Paris, a counsellor of the Penns, testified that in his presence and hearing during the preparation of the Agreement of May 10, 1732 it was agreed between Lord Baltimore and the Penns that "the Lord Baltimore's Map or Plan should be the Map or Plan that should be engraved, and that the said Mr. Senex (who had been named by the said Lord Baltimore) should engrave the same; . . ." Mr. Paris testified further that these agreements were carried into execution.³

John Senex lived until December 30, 1740;⁴ twenty years later, on December 20, 1760, Governor Horatio Sharpe of Maryland wrote to Frederick Lord Baltimore suggesting that Senex's advice be sought. From 1710 until his death Senex published a series of famous maps and geographies. He was elected a fellow of the Royal Society on July 4, 1728. Ten years later he read before the Society a paper on "a Contrivance to make the Poles of the Diurnal Motion

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It is a pleasure to acknowledge courtesies that have been extended through the years by members of the staffs of the libraries of the American Philosophical Society, of the Historical Society of Pennsylvania, and of the University of Pennsylvania.

Correspondence of Thomas Penn is quoted freely. It is filed in chronological order in the Penn Letter Books, Official Correspondence, at the Historical Society of Pennsylvania.

Correspondence of Governor Horatio Sharpe is published in chronological order in *Archives of Maryland*. Volumes 6, 9, 14, and 21, part II, are devoted to this correspondence.

Great assistance has been received from the bibliography entitled "Manuscripts and Publications Relating to the Mason and Dixon Line and Other Lines in Pennsylvania, Maryland and the Virginias" by Edward L. Burchard and Edward B. Mathews, published in the "Report on the Resurvey of the Maryland-Pennsylvania Boundary," Secretary of Internal Affairs, Harrisburg, 1909, and in *Maryland Geological Survey* 7, Baltimore, 1908.

² *Penna. Archives*, ser. 1, 4: frontispiece; *Penna. Archives*, ser. 2, 16: facing page 1.

³ *Penna. Archives*, ser. 2, 16: 567.

⁴ *Dictionary of National Biography*.

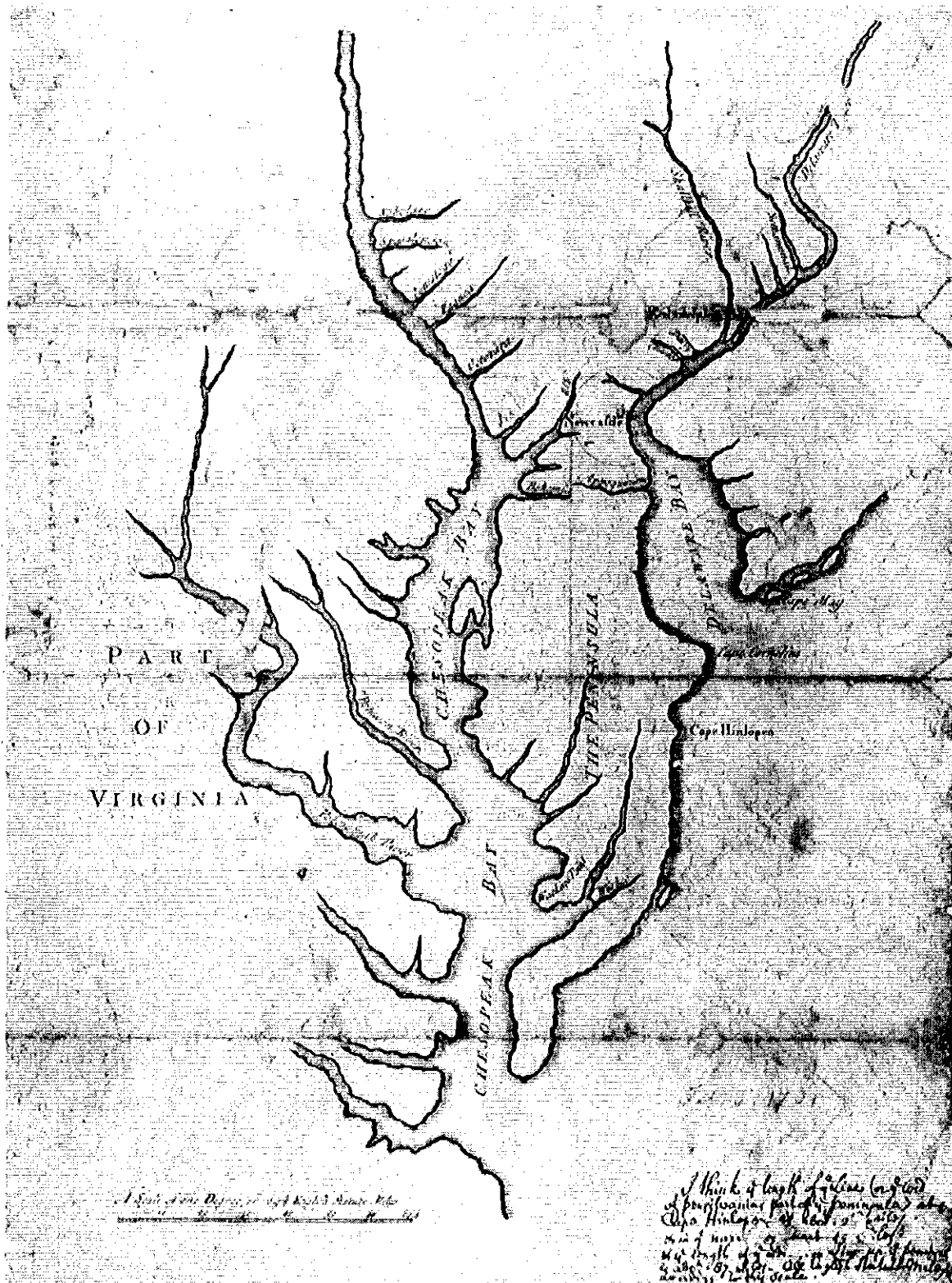


FIG. 1. "This is the first proof of the Plate to describe the Bounds between Pensilvania & Maryland. Graved 3 Feby. 1731 by Mr. Senex." Courtesy of the Historical Society of Pennsylvania.

in a Celestial Globe pass round the Poles of the Ecliptic."⁵

The boundaries described in the agreement of May 10, 1732, were: (a) a Circle (mentioned in the Charter of Pennsylvania) to be marked out at twelve English statute miles from the town of New Castle; (b) a due east and west line to be run from the tip of Cape Henlopen, which lies south of Cape Cornelius, on the Main Ocean, towards the western side of the Peninsula, which lies upon Chesapeake Bay, but to end in the exact Middle of the Peninsula; (c) a straight line run northward up the Peninsula from the Middle of the Peninsula, as shown by the western end of the transpeninsular line just described, until it became tangent to the Circle on its western side; (d) a straight line run due northward from the Point of Tangency until it attained a latitude fifteen English statute miles south of the most southern part of the City of Philadelphia; (e) a due east-west line run from the northern end of the line last described, due westward across the Susquehanna River and at least twenty-five English statute miles beyond; ultimately it should reach the westernmost limits of Pennsylvania; (f) the boundaries between Maryland and the three Lower Counties of Sussex, Kent, and New Castle and between Maryland and Pennsylvania should be (1) the east-west line from the tip of Cape Henlopen to the Middle of the Peninsula, (2) the tangent line from the Middle Point to the Point of Tangency, (3) the south-north line from the Point of Tangency to the latitude fifteen English statute miles south of the South Point of Philadelphia; if this line should intersect the Circle (as it did) then from the tangent point to the point where the line leaves the Circle the arc of the circumference lying west of the line should be the boundary, thus placing all of the Circle in New Castle County; (4) finally the east-west line run westward from the point due north of the Tangent Point and fifteen English statute miles south of the South Point of Philadelphia.⁶

⁵ *Phil. Trans.* 40: 203, 1741.

⁶ Maps of former years showed a little wedge of "Pennsylvania soil" at the northeast corner of Maryland extending southwards for three and a fraction miles between the circumference of the twelve mile circle and the eastern boundary of northeasternmost Maryland. This "wedge" was ceded to Delaware by Pennsylvania in 1921. The residents of the "wedge" had ignored the sovereignty of Pennsylvania for years and had conducted themselves as citizens of Delaware.

The Parallel now extends eastward to the circumference of the Circle. The Meridian of the Tangent Point

The agreement of May 10, 1732, left many questions unanswered. Many of them were about real obscurities. Contentious partisans soon found other chances for argument. As instances—

Around what center should the Circle at New Castle be drawn? Was the twelve miles its radius? diameter? circumference? or what?

Should distances over ground be measured superficially, that is up hill and down dale, or horizontally?

Just where was Cape Henlopen? and where its tip?

What is an east-west line? Is it a parallel of latitude? or an arc of a great circle run perpendicular to the meridian through its point of origin?

And just where was the eastern shore of Chesapeake Bay? Was the eastern shore of a tide-water creek that entered the Bay also the shore of the Bay?

Although an agreement had been signed in good faith, work of surveying and marking the boundaries made no progress because of these contentions. Both parties appealed to the King in Council and the Penns seized upon a suggestion heard in Council that a suit in equity be filed. On June 21, 1735, they entered suit in Chancery against Charles Lord Baltimore praying that the agreement of May 10, 1732 might be decreed "to be in full force and virtue . . . and to be forthwith specifically performed, and to be carried into full force and execution. . . ." Through the 1730's, the 1740's, and into the 1750's "the said cause was carried on in an adversary manner and at great expence, and being regularly at issue, great numbers of witnesses were duly examined therein on each side, both in America and in Great Britain."⁷

Surveying and marking of the boundaries was not entirely at a standstill during the years of litigation. For in response to repeated complaints from both provinces about riots and disorders on the borders the King in Council ordered the governors of Maryland and Pennsylvania to suppress lawlessness along the boundaries and to make no grants of land in disputed territory. This order brought Baltimore and the Penns into agreement to propose a temporary boundary between the provinces, to lie south of the most southern part of Philadelphia fifteen and one quarter miles on the eastern side of the Susquehanna, fourteen and three quarter miles on the western side. This

lies within the Circle as a chord. North of the Circle it is now a boundary between Maryland and Delaware.

⁷ Quoted from the Final Agreement which was signed on July 4, 1760.

agreement was confirmed by an order of Council on May 25, 1738. The temporary boundary was surveyed and marked in a temporary way during 1739 from its eastern extremity to the mountains just west of the Cumberland Valley. It remained the accepted boundary until the final survey was completed during the 1760's.

The 1730's had been a lively decade in the history of the boundary disputes. In contrast the 1740's proved to be rather humdrum. Evidence, arguments, and petitions continued to be submitted to the High Court of Chancery but nothing decisive happened. Thomas Penn in 1749 suggested to his governor that Lewis Evans, map-maker, and John Bartram, botanist, be employed to reconnoitre the boundaries of Pennsylvania secretly while apparently going about their usual pursuits. No surveyors were to accompany them. Nothing positive came from this suggestion.⁸

The 1750's began auspiciously. On March 16, 1750 the Penns petitioned the High Court of Chancery that the Circle around New Castle should be run twelve miles from center by horizontal measure and that the fifteen miles south from Philadelphia should be measured in the same way. Only a short time before Robert Henly, a distinguished jurist, had given opinions that superficial measures should be used. He held that the tip of Cape Henlopen should not be taken from maps but should be determined by the best evidence to be secured.

And on May 15, 1750 Lord Chancellor Hardwicke issued his first decree on the Articles of Agreement of 1732. He found them to be "valid and obligatory" and ordered them "to be specifically executed and performed." He ruled that the Circle was of twelve miles radius about the middle of the town of New Castle, and that Cape Henlopen should be located from the map attached to the Articles.

On March 1, 1751, Martin Folkes, Peter Daval, and John Robertson, all distinguished Fellows of the Royal Society, made depositions before the High Court to the effect that the Circle should be marked at twelve miles from New Castle according to horizontal lines. And four weeks later the Lord Chancellor ordered that measurements be made horizontally and not superficially. From 1751 onward John Robertson was principal scientific advisor to the Penns, and questions were later

referred by them to Peter Daval. Due process of law patiently adhered to through long years, and the advice of the best scientific talent in the realm, had decided issues that had kept two neighboring provinces in unrest for decades. From the early 1750's scientists and technologists gradually replaced political and legal advisors in the issues of the boundary surveys.

Immediately following the decision of the Lord Chancellor, announced on May 15, 1750, commissioners to survey and mark the boundaries were named, as agreed, by both proprietors. They made no progress in running the Circle around New Castle because of disagreements but they did agree upon a point on the shore of Fenwick Island as the tip of Cape Henlopen. From this point their surveyors during 1751 ran a line westward across the Peninsula until it reached the shore of the Chesapeake. But the commissioners of Maryland and those of Pennsylvania failed to agree, by a matter of 3 miles and 50 perches, as to just where that shore lay. But by July 4, 1760, Thomas and Richard Penn and Frederick Lord Baltimore, son and heir of his late father Lord Charles, had agreed amicably that their surveyors had selected the right point as the tip of Cape Henlopen and that the greater length of the transpeninsular line was the correct one. And they had agreed too that the court house in New Castle was at the center of the town and therefore at the center of the Circle of radius twelve miles. This unanimity had flowered in the climate of the High Court of Chancery.

The transpeninsular line as surveyed in 1751 was accepted by both Baltimore and the Penns as a "true east-west line." An inspection of the appropriate maps issued by the U. S. Geological Survey will show even a casual inquirer that the southwest corner of Delaware, "the Middle Point," lies almost three-quarters of a mile north of the stone set up by the surveyors on Fenwick Island. The provincial surveyors who ran the line in 1751 were responsible and honest, but they could not run an east-west line with such precision as Mason and Dixon attained fifteen years later.

While the survey of the transpeninsular line was in progress during April, 1751, Charles Lord Baltimore, one party to the Agreement of May 10, 1732, passed away. He was succeeded by his minor son, Lord Frederick, last Baron of Baltimore. No further progress in the surveying and marking of the boundaries was made until the late autumn of 1760. But the High Court of Chan-

⁸ The story is an entertaining one and is well told in L. H. Gipson's *Lewis Evans*, chap. III, Philadelphia, Hist. Soc. Penna., 1939.

cery was still accessible to both parties and their legal advisors were not idle. On April 7, 1757, Cecilius Calvert, uncle and secretary to Frederick Lord Baltimore, wrote to Governor Horatio Sharpe of Maryland that "Not anything as yet has been carried into execution between Lord Baltimore and Messrs. Penns with respect to Boundaries, the matter is under reference with Lawyers on both sides."⁹

Counsel for Frederick, sixth and last Lord Baltimore, and for Thomas and Richard Penn produced the Final Agreement between the two parties. It recited and reaffirmed the Articles of Agreement of May 10, 1732, repeated and accepted all rulings of Chancery in the case of Penns *vs.* Baltimore, accepted the work of the commissioners and their surveyors who ran the transpeninsular line in 1751, accepted horizontal instead of superficial measurement, agreed that the Circle about New Castle centered in the court house in that town and was to be of radius 12 English statute miles measured horizontally.

The Indenture of Agreement was signed by Baltimore and the Penns, on July 4, 1760. It was enrolled in the High Court of Chancery on the same day. On the following day Baltimore named seven commissioners from Maryland and the Penns seven from Pennsylvania and the Lower Counties to work together in surveying and marking the boundaries. During the next eight years the work was carried to completion.

The months from July, 1760, until the late autumn of 1763, when Mason and Dixon took over the survey, were busy, strenuous ones for the proprietors, their governors, Sharpe of Maryland and Hamilton of Pennsylvania, and for their commissioners. Scientific and technological advice was now needed on how to lay out the Circle, how to run the Tangent Line, how to run the south-north line northwards from the Tangent Point, how best to lay off a latitude of fifteen English statute miles south from the South Point of Philadelphia, and how to run an east-west line in that latitude westward for over two hundred miles. What principles to observe? What methods to employ? What instruments to use? Where to get them? What personnel to engage?

Scholars from the Middle Colonies were brought into the survey as advisors. Their names and contributions will be treated in a later paper. For the present attention will be focussed upon an ar-

⁹ *Archives of Maryland*, Correspondence of Governor Horatio Sharpe.

ray of British scholars who were engaged to advise the proprietors and their commissioners. John Senex, the map-maker, had prepared the original map of the boundaries. He had died in 1740, but his map was still a part of the Final Agreement of 1760. Martin Folkes, Peter Daval, and John Robertson were mentioned as witnesses before Chancery in March, 1751. And Robertson has been spoken of as the principal scientific adviser of the Penns. He played a leading role during the early 1760's while the survey was being organized.

John Robertson, mathematician, was born in 1712. From 1748 to 1755 he was master of the Royal Mathematical School in Christ's Hospital. It was during this period that he first advised the Penns. In 1755 he became first master of the Royal Naval Academy at Portsmouth and he held this post until 1766. During this period Thomas Penn sought his advice repeatedly. Penn laments now and then in a letter that "Mr. Robertson is now in Portsmouth." He returned to London after 1766 and served the Royal Society in various capacities until his death in 1776. He was a Fellow of the Royal Society, and author of famous treatises that are still consulted, on navigation, on mensuration, and on mathematical instruments. He contributed nine papers on mathematical and physical subjects to *Philosophical Transactions* between 1750 and 1772.¹⁰

John Robertson contributed in a major way to the organization of the survey in America by suggestions that he originated and by his criticisms and evaluations of the suggestions of other men. These will be treated in a later paper. Robertson contributed also his share of ideas that proved to be of no service. The incident now to be related may serve as an illustration.

In a letter written on January 9, 1761, to Provincial Secretary Richard Peters, who was a commissioner for Pennsylvania, Thomas Penn said:

On looking over my Papers I find I never sent a Scheme of Mr. Robinson's¹¹ which was to run the Lines by short Triangles, from a Base of Seven or Eight Miles, run on the Ice, as it is level; it was proposed to run from Newcastle up the River, that Base, and from thence continue the Triangle thro the whole Work. . . . Lord Sterling's Clerk is making the Triangles to a Copy or I would have sent one, but propose to send one on Tuesday. If this

¹⁰ *Dictionary of National Biography*.

¹¹ Now and then Thomas Penn wrote Robertson's name as Robinson.

should get to you, which is not at all probable, before the River opens, you may try it.

Robertson was probably influenced by the example of a group of famous French Academicians who during the middle 1730's had measured an arc of meridian by triangulation in Finland. "The base was measured on the frozen surface of the river Tornea, nearly in the direction of the stream; the extremities of the base were on the land." Of course neither John Robertson nor Thomas Penn could bring the climate of Lapland to the Delaware.¹²

Martin Folkes (1690-1754), antiquary and man of science, was president of the Royal Society from 1741 to 1752. He was educated in France and at Cambridge, and was elected to the Royal Society in 1714. During Isaac Newton's presidency of the Society he served for a time as a vice-president and often presided in Sir Isaac's absence. In 1742 Folkes was elected to the French Academy as successor to Edmond Halley. He was a fellow of the Society of Antiquaries and filled its presidency from 1750 to 1754. He is spoken of as a man of extensive knowledge, upright, modest, affable.¹³

Peter Daval, a barrister of the Middle Temple, was Secretary of the Royal Society from 1747 to 1759. He contributed papers on astronomy to *Philosophical Transactions*.

The alteration in the British calendar, or, as it was called, Change of Style, took place in 1752. . . . The authority for the alteration emanated from Parliament, but the Royal Society had considerable share in effecting the change. . . . Lord Macclesfield, in his speech in the House of Peers, on the second reading of the Bill, "for regulating the commencement of the years," stated that "the Bill was drawn, and most of the Tables prepared, by Mr. Daval . . . whose skill in astronomy, as well as in his profession, rendered him extremely capable of accurately performing that work; which was likewise carefully examined and approved of by two gentlemen, whose learning and abilities are so well known . . . ; I mean Mr. Folkes, President of the Royal Society, and Dr. Bradley, his Majesty's Astronomer at Greenwich. Upon this authority do the new Tables and Rules stand."¹⁴

Commissioners of Maryland and of Pennsyl-

¹² Todhunter, *History of the theories of attraction and the figure of the earth* 1, chap. 7, p. 97, London, 1873. Delambre, *Grandeur et figure de la terre*, chap. 2, Première mesure de l'arc de Laponie, Paris, 1912. Maupertuis, *La Figure de la terre*, Paris, 1738.

¹³ C. R. Weld, *History of the Royal Society*, chap. XVII, London, 1848. *Dictionary of National Biography*.

¹⁴ Weld, *History of the Royal Society*, 514-515.

vania and the Lower Counties held their first joint meeting of the final survey in New Castle during November, 1760. Both Governor Sharpe of Maryland and Governor Hamilton of Pennsylvania were present as commissioners. Upon his return to Annapolis after the meeting, Governor Sharpe wrote to Lord Baltimore suggesting that advice be sought from distinguished scientists. He said in his letter of December 20, 1760:

. . . I should be very glad if Your Ldp would submit some queries which I shall take the Liberty to transmit & such others as Your Ldp may think fit to the Consideration of some Gentn who have devoted a great part of their Lives to the Study of the Mathematicks & whose Reputation is established, such I presume are Doctor Bradley Regius Professor of Astronomy at Greenwich, Mr. Senex the Map Maker & Mr. Cockayne who reads Lectures at Gresham College. . . .¹⁵

Of the scientists mentioned by Governor Sharpe, Mr. Senex had died in December, 1740, and Dr. James Bradley, Astronomer Royal at Greenwich, was aged and ill. He had given up all active work. And if Rev. William Cockayne, who held the chair of astronomy at Gresham College from 1752 to 1795, was approached for advice no evidence of it has been found. However an adviser was found. He first appears in the correspondence early in 1761 and during the three years following he is referred to at least sixteen times in the correspondence of Governor Sharpe and at least fourteen times in the letters of Thomas Penn. A number of documents that he prepared or helped to prepare are preserved. He was Dr. John Bevis, physician and distinguished amateur astronomer. He was the principal scientific adviser to Lord Frederick Baltimore and to his uncle and secretary, Cecilius Calvert. It is gratifying to note that on many occasions Dr. John Bevis and John Robertson, adviser of the Penns, worked together when counselling the proprietors about the survey.

John Bevis, M.D. (1693-1771), took the degrees of B.A. and M.A. at Christ Church, Oxford, then studied medicine, all the while cultivating optics and astronomy. He made the grand tour, then settled in London as a practicing physician. In 1738 he removed to Stoke Newington, north of London, where he built and equipped an astronomical observatory. His observations and publications won him standing as an astronomer. He

¹⁵ *Archives of Maryland*, Correspondence of Governor Sharpe.

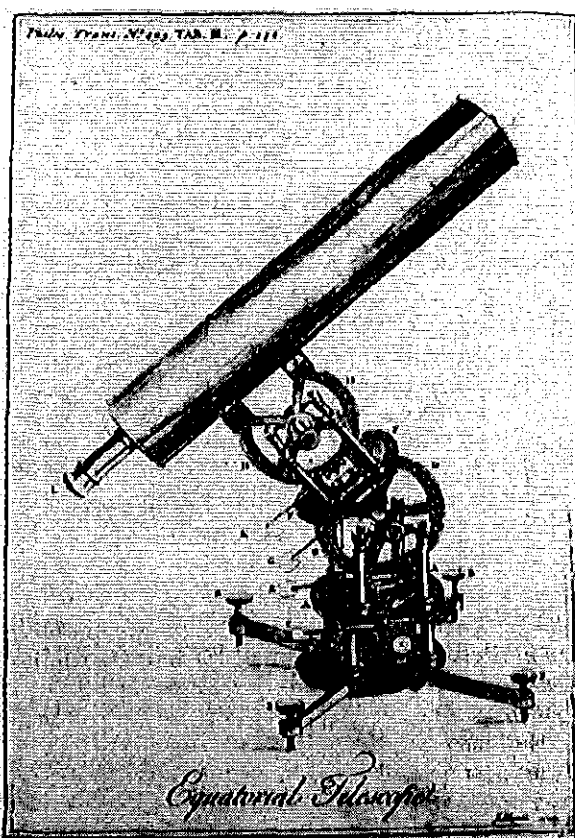


FIG. 2. Reproduced by kind permission of President and Council of the Royal Society.

was elected a Fellow of the Royal Society in 1765, and was similarly recognized by the Academies of Sciences of Berlin and of Paris. He was friend and co-worker of Edmond Halley and of Rev. James Bradley, the second and the third Astronomers Royal to direct the Royal Observatory at Greenwich.¹⁶

The fact that Dr. Bevis enters the official correspondence as principal adviser to Lord Baltimore and his uncle Cecilius Calvert about the time when Governor Sharpe's letter advising that they consult Dr. Bradley probably arrived suggests that Dr. Bradley may have recommended Dr. Bevis to Lord Baltimore and Mr. Calvert. As the official correspondence develops it reveals that about 1750 Dr. Bevis had been concerned with an ambitious surveying project which involved the running of a parallel of latitude and of a meridian on Salisbury Plain. While working on this project Dr. Bevis had made some use of a "transit instrument." It seems quite probable that the instrument referred to was one made and de-

¹⁶ *Dictionary of National Biography.*

scribed by James Short. The drawing of it is here reproduced as figure 2.

In the description of this instrument, which is called an Equatorial Telescope, it is explained that by making the Equatorial Plates parallel to the Horizontal Plates the instrument becomes an "Equal Altitude Instrument, a Transit Instrument, a Theodolite, a Quadrant, An Azimuth Instrument, and a Level." It is mentioned that the instrument could be used to find the meridian of a place quite accurately and also the latitude. Short had made three of the instruments.¹⁷

Dr. Bevis was not an instrument maker and he would naturally have gone to James Short to make such instruments as he required for any project to be undertaken. In a paper published in the next volume of *Philosophical Transactions* Bevis mentions that Short had permitted him to use one of his three instruments for some astronomical observations.¹⁸

In 1760 the instrument that Dr. Bevis had used on Salisbury Plain was still in existence but not in use. Dr. Bevis commended it so highly for use on the boundaries in America that all parties called for it. It was brought up to London and inspected by Mr. Calvert, Thomas Penn, and others. Mr. Penn was not enthusiastic about it but when Mason and Dixon arrived in Philadelphia in November, 1763, they had with them "Dr. Bevis's transit instrument." It was set up in Philadelphia and was inspected there by the Commissioners of both Maryland and Pennsylvania and by Mason and Dixon. The latter openly preferred a transit instrument which they had brought with them, built by John Bird for the Penns. The Commissioners instructed them to use the Bevis instrument as their judgments might suggest. No records of its use in America have been met.¹⁹

That Mason and Dixon brought "Dr. Bevis's transit instrument" to America is proved by a letter which Cecilius Calvert wrote to Governor Sharpe on August 17, 1763. Calvert was sending the instrument.²⁰ The decision of the commis-

¹⁷ *Phil. Trans.* 46: 241-246, 1749-1750.

¹⁸ *Phil. Trans.* 47: 159-163, 1751-1752.

¹⁹ For prolonged efforts to find records of the surveying project of 1750 and of the transit instrument that was used in it the authors are indebted to a number of gentlemen in England and in America. Special mention is made of Mr. D. Chilton of the Science Museum, South Kensington, London, and of Mr. Walter D. Lambert of Canaan, Connecticut, retired from the U. S. Coast and Geodetic Survey.

²⁰ Original manuscript letter is in the Emmet collection in the New York Public Library. It is apparently

sioners about the use of the instrument is revealed in a letter from Governor Sharpe to Cecilius Calvert, dated December 28, 1763. It says:

The Commissioners are to meet in order to judge of their Work & to give them Instructions relative to their running the West Line [the parallel], which it seems after all that has been said of the Transit Instrument cannot be thereby truly or precisely described there being no Movement that Messrs. Mason & Dixon could shew or the Commissioners discover to bring & keep its Telescope in the plane of a Parallel of Latitude: It was however delivered by our [Maryland] Commissioners to the two Gentlemen to be used as they should see occasion, tho they seemed to think a less complex & more portable Transit Instrument which they brought with them from Mr. Penn would be of more general use to them in running the several Lines required.²¹

Daniel Harris, a mathematician and astronomer, and master of the Royal Mathematical School in Christ's Hospital, succeeding John Robertson when the latter moved to Portsmouth in 1755, appears in the letters of Thomas Penn early in 1761. Penn had confidence in the mathematicians at Christ's Hospital. For his attainments and contributions Daniel Harris was elected a Fellow of the Royal Society.²²

In a letter written to Provost William Smith of the College of Philadelphia on January 10, 1761, Thomas Penn says: "I have desired the thoughts of Mr. Harris Master of the Mathematical School at Christ's Hospital on your proposition. . . ." And in a letter to Secretary Richard Peters written on March 13, 1761, Mr. Penn, while discussing the running of the Tangent Line, mentions a "Proposition from the Master of the Mathematical School at Christ's Hospital which requires finding latitudes and longitudes of Newcastle and Fenwick's Island. We must not agree to it as we have been preaching about the uncertainty of celestial observations." The Historical Society of Pennsylvania preserves among its Penn Manuscripts—Boundaries two documents credited to Daniel Harris, one on running the Tangent Line, the other on running the Parallel.

And when Mason and Dixon were leaving for not included among correspondence published in the Archives of Maryland.

²¹ *Archives of Maryland*, Correspondence of Governor Sharpe.

²² Daniel Harris is confused with Joseph Harris, assay master of the mint and author of scientific and mathematical works, in the Bibliography published by E. L. Burchard and E. B. Mathews in *The resurvey of the Maryland-Pennsylvania boundary*, 333, Harrisburg, Pa., Harrisburg Pub. Co., 1909, and in *Maryland Geological Survey 7*: 333, Baltimore, 1908.

America Thomas Penn wrote to the commissioners for Pennsylvania on August 31, 1763, a letter which was carried by the two surveyors. It said in part: "We have also consulted two other very able Mathematicians, Doct Bevis & Mr. Harris, on some points tending to facilitate this business, & enclose you a Copy of their opinion, signed by Mr. Calvert & us." The "Hints from Messrs Bevis and Harris . . . about running tangent Line and Parallel of Latitude" were adopted by the commissioners in December, 1763, for the guidance of Mason and Dixon. They will be considered in a later paper.

On May 22, 1762, Thomas Penn wrote to Governor Hamilton, to Secretary Peters, and to the Pennsylvania Commissioners for surveying and marking the boundaries and in each of these letters he reveals that questions concerning the survey had been referred by him to a Dr. Blair for study and comment. In a postscript to his letter to the commissioners, dated May 28, Mr. Penn says: "Your letter of the 14th of November with a Sett of all the Papers has been for some time past with Dr. Blair who has just returned them to me." Mr. Penn summarizes the Doctor's advice much as follows: he approves making the Tangent Line by offsets from the Meridian; he thinks the parallel of latitude can be most certainly done by observations made with the [Zenith] sector which is now making [by John Bird]; he suggests that Dr. Bevis's transit instrument may be of use to compare with the other work, but I find that he does not depend greatly upon it; "he thinks the instrument you wrote for will not now be of any use."

On January 31, 1763, Mr. Penn sent a letter to Dr. Blair accompanied by books and other exhibits. A list is appended to the letter, viz.—"a brief of Penn and Baltimore; a quarto book in which is Lord Baltimore's map printed in 1635; collection of charters; state of the claims between Maryland and Pennsylvania; letter about the boundaries of said provinces." Apparently Dr. Blair had become interested in the Penn-Baltimore question and was setting about to master it from the beginning.

And on August 21, 1763, Governor Sharpe in a letter to Cecilius Calvert remarked:

Dr. Bevis recommended to us a superior instrument for running the lines far better than any we have been able to use. The instrument is still in England and we see no prospect of getting it, to judge from Dr. Bevis's letter, "because of an erroneous Opinion entertained by Dr. Blair & by him instilled into Mr. Penn."

"Dr. Blair" appears to have been John Blair, L.L.D. (?-1782), a chronologist who was educated in Edinburgh and then settled in London and took orders. He published a chronology and history of the world. He was elected a fellow of the Royal Society. In 1757 he was appointed chaplain to the Princess Dowager of Wales and mathematical tutor to the Duke of York. In September, 1763, Dr. Blair left England with the Duke of York on a tour of the continent. In later years he published fourteen maps of ancient and modern geography and served as vicar of St. Bride and rector of St. John the Evangelist, London.²³

To the foregoing is to be added a note—On Saturday morning June 6, 1761, at the invitation of H.R.H. the Duke of York those named below joined H.R.H. at Savile House to observe the transit of Venus—Rev. Dr. Blair, Dr. Bevis, James Short, Prince William, Prince Henry, Prince Frederick, and H.R.H. Lady Augusta.²⁴

During April and May of 1761 Thomas Penn mentions a Mr. Simpson of the Academy at Woolwich in his letters to Governor Hamilton and to Secretary Peters. He describes him as "second Master of the Academy at Woolwich . . . he has been recommended to me as the fittest Person to give these directions." To Mr. Simpson, Mr. Penn had submitted a series of questions raised by Provost William Smith of the College of Philadelphia on the best method of running the east-west line that was to lie fifteen miles south of the South Point of Philadelphia.

And in a letter to Secretary Richard Peters written on May 9, 1761, Mr. Penn says: "Mr. Simpson the Master of the Academy at Woolwich being in the North of England and to stay there a very long time, I have sent the Queries to Mr. Robertson, Master of the Academy at Portsmouth, who will be soon in Town. . . ."

"Mr. Simpson" was Thomas Simpson (1710-1761), a weaver, and self-educated mathematician of such stature that the Royal Society made him a fellow in 1745. He was born in Leicestershire. The solar eclipse of May 11, 1724, aroused his interest in science. He went up to London and there followed his trade and taught mathematics. Simpson published "A New Treatise on Fluxions" and was elected to the Royal Academy of Stockholm. In 1743 he was chosen professor of mathe-

matics at the Royal Academy at Woolwich. He was the author of nine books on mathematical subjects and of a number of papers published in *Philosophical Transactions*. In May, 1761, when Thomas Penn wrote to Richard Peters, Simpson was ill in Leicestershire. He survived only a few days.²⁵

The Proprietors of East Jersey owned a quadrant which they had purchased in 1745 from Jonathan Sisson, famous instrument maker of London, for use in running their northern boundary. During the 1760's this instrument was in the custody of the surveyor general of New Jersey, William Alexander, Earl of Stirling, a personal friend of the Penns. Thomas Penn borrowed the quadrant for use in the boundary survey. Little if any use was made of it for with it latitudes could be determined only to half-minutes.²⁶

In a letter to Lord Stirling written on May 20, 1762, Thomas Penn told him:

We are advised to send a a Six feet Sector to mark points for running a parallel of Latitude; Lord Baltimore has sent one by Sisson and I have bespoke one of Bird, that I hope to send about two months hence. this he says will fix points to two seconds.

Penn continued to mention the zenith sector that John Bird was making for him in letters written month after month, on May 22 to the Commissioners, on July 10 and on August 14 to Governor Hamilton, on August 14 to Secretary Peters. On November 13, 1762, Mr. Penn said in a letter to Governor Hamilton,

I have pressed Mr. Bird very much to finish the Sector, and yesterday Mr. Calvert, Dr. Bevis and myself saw it put together and examined it, the Doctor says it is very well executed and a most curious Instrument, much more so than that sent by Lord Baltimore, and will cost three times the price; there are some small things to it not quite finished, that will be the Week after next when I shall come to Town to have it examined by several skillful Persons and have several observations made by it.

The zenith sector made by Bird and also a transit instrument by him were the principal instruments that Mason and Dixon brought to America in the autumn of 1763. These two instruments in the hands of Mason and Dixon set the standards of the final survey. Bird's zenith sector was used by Samuel Holland and David Rittenhouse in 1774 while starting the survey of

²³ *Dictionary of National Biography*.

²⁴ From a report by James Short, F.R.S., published in *Phil. Trans.* 52 (1): 178-182, 1762.

²⁵ *Dictionary of National Biography*.

²⁶ T. D. Cope, The Jersey quadrant used in Pennsylvania, *Proc. Amer. Philos. Soc.* 97 (5): 565-570, 1953.

the northern boundary of Pennsylvania.²⁷ There are traditions that it survived until recent years and was finally lost in the fire that destroyed the Capitol at Harrisburg in February, 1897.²⁸

Perhaps the zenith sector made for Lord Baltimore by Jonathan Sisson is referred to by Charles Mason in an entry in his *Daily Journal* made on December 6, 1763, while he and Dixon were meeting the Commissioners of both provinces in Philadelphia, just after their arrival in America. The entry reads:

1763, Dec. 6th. Set up a Sector brought by the Commissioners from Maryland and found the Nonius would not touch the middle part of the Arch.²⁹

Jonathan Sisson (1690?-1760?), mathematical instrument maker, had a business at the corner of Beaufort Buildings in the Strand, London. Many of the well-known clockmakers and instrument makers of the eighteenth century were employed by him. Some received instruction from him. His instruments were well known, and in fact still are. They were described by a contemporary writer "as the best, most complete, handsome, and well designed instruments possible."

John Bird (1709-1776), a cloth-weaver of the county of Durham who had become expert in the dividing of clock dials, came up to London about 1740 and was employed by Sisson. He came to the attention of George Graham (1675-1751), the most famous instrument maker of his time, and was instructed by him. As the mechanical coadjutor of Rev. James Bradley, Astronomer Royal at Greenwich, Bird became famous throughout the scientific world.

The brass quadrant of radius eight feet, which Bird made for Bradley in 1749-1750, made possible the consummate accuracy of Bradley's work and marked an epoch in practical astronomy. It is still preserved at Greenwich. A half-size model of it was placed in the British Museum by order of the Commissioners of Longitude. Duplicates

²⁷ *Surveys and Resurveys of the Boundary Lines of the Commonwealth*, a Report of the Secretary of Internal Affairs, 495, Harrisburg, 1887.

²⁸ *Report on the Resurvey of the Maryland-Pennsylvania Boundary*, 40, Baltimore, 1908, Harrisburg, 1909. Through the courtesies of Mr. R. N. Williams, member of the Pennsylvania Historical and Museum Commission, and Dr. S. K. Stevens, State Historian, Dr. Norman B. Wilkinson, Assistant State Historian, has made a thorough inquiry into this tradition. He has found no confirmation and no trace of the instrument.

²⁹ Charles Mason's *Daily Journal*, original in National Archives, Washington, D. C.; photographic copies in Library of the American Philosophical Society.

of it were made for observatories in St. Petersburg, in Cadiz, and in L'Ecole Militaire.

Bird supplied for Bradley a new transit instrument and a 40-inch movable quadrant, and he put fresh divisions upon a mural arc at Greenwich which George Graham had constructed for Astronomer Royal Edmond Halley.

Bird was engaged by the Commissioners of Longitude to "instruct an apprentice for seven years in his methods, and to deliver in writing, upon oath, a full and unreserved account of them." Two books written by John Bird were the outcomes: *The Method of dividing Astronomical Instruments*, London 1767, and *The Method of constructing Mural Quadrants*, London 1768.³⁰

In their excellent bibliography of "Manuscripts and Publications relating to the Mason and Dixon Line . . ." ³¹ E. L. Burchard and E. B. Mathews enter the following item:

1761. Feb. Demonstration by Dr. Robert Smith.
 "Scheme for running the tangent lines."
 2 pp. fol. with diag.
 Ms. Copy. Pa. Hist. Soc., Penn Mss.—
 "Boundaries," p. 94.
 Notes. Dr. Smith was professor of astronomy and Vice Chancellor of Cambridge University and founder of its Smith mathematical prizes.

This appears to be a case of mistaken identity. The "scheme" in question provoked a correspondence between its author, Dr. Smith, and Thomas Penn that continued through years. Penn referred the "scheme" to Daniel Harris, to Thomas Simpson, and to John Robertson for criticism. Its author was Provost Rev. William Smith of the College of Philadelphia. Provost Smith was most anxious to serve as a commissioner for Pennsylvania. He was not appointed.

There have now been named all of the British scientists and technologists who are known to have advised Lord Baltimore and Cecilius Calvert and Thomas and Richard Penn during the period when the final survey of their common boundaries was being organized, equipped, and staffed. Some Americans participated in this undertaking. They are still to be presented. And the methods and instruments that were proposed and evaluated are still to be considered. Some of them survived the criticism and were put to use. They will be dealt with in a future paper.

³⁰ *Dictionary of National Biography*.

³¹ *Report on the Resurvey of the Maryland-Pennsylvania Boundary*, Harrisburg, 1909, and *Maryland Geological Survey 7*, Baltimore, 1908.