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John Horsley, James Jurin and the Royal Society Meteorological Network

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SUMMARY

John Horsley (1685–1732) is well known as a Presbyterian minister, schoolmaster and antiquarian, author of the monumental *Britannia Romana*. This paper examines his scientific interests, and particularly his meteorological work, using newly-discovered correspondence between Horsley and Dr James Jurin, Secretary of the Royal Society, to investigate the context of Horsley's meteorological paper in *Philosophical Transactions*. The complete set of Horsley's weather diaries (or Registers) has also survived in the Royal Society, and Horsley is shown to be a careful analyst of weather processes and a key stimulus to the creation of the Royal Society's attempt to construct a meteorological network. These letters and weather Registers also provide a fuller portrait of Horsley the man.

INTRODUCTION

John Horsley has an enduring reputation as an antiquarian, one of the key figures in the early period of Roman archaeology in Britain as author of *Britannia Romana*.¹ Born in Northumberland in 1685, educated at Newcastle Grammar School and Edinburgh University, Horsley was Presbyterian minister and schoolmaster at Morpeth from before 1709 to his early death in 1732. Much detail of his life is inevitably unknown, but his interests in science as well as antiquities are evidenced through his series of public scientific lecture courses.²

Accounts of Horsley's life note his one scientific paper, published in the *Philosophical Transactions* of the Royal Society in 1723: 'An

Account of the Depth of Rain fallen from April 1 1722, to April 1, 1723. Observed at Widdrington in Northumberland, and communicated to the Publisher by the Reverend Mr. Horsley'.³ This has always been an isolated item in Horsley's biography, without any context or background. However, the recent cataloguing of the letters of Dr. James Jurin, Secretary of the Royal Society, has revealed archives at the Royal Society and the Wellcome Library containing exchanges between Horsley and Jurin on scientific issues, including meteorology, and it is these letters and the accompanying weather diaries (or Registers) that form the basis for the present paper. They demonstrate Horsley playing a role in the scientific discourse of the period, revealing his deeper interest in meteorological processes and his contribution to the Royal Society meteorological network. Indeed, the case can be made that Horsley's own recording was the stimulus (if not the ultimate origin) for Jurin's projects.

The two men, Horsley and Jurin, had much in common. They were almost exact contemporaries, born within a year of each other. They both had Tyneside and Northumbrian roots, Jurin through his mother's family. Both had connections with Newcastle Grammar School, Horsley as a pupil and Jurin as headmaster for six years. The two shared scientific and antiquarian interests, and both became Fellows of the Royal Society.

Subsequent sections first outline the existing evidence for Horsley's scientific interests, then describe Jurin's career, north-east connections and scientific work, before turning to examine the detail of the Horsley-Jurin correspondence,

Horsley's weather Registers and the significance of his meteorological work. An appendix discusses confusions between several John Horsleys.

HORSLEY'S SCIENTIFIC INTERESTS

Horsley's scientific interests have been recognised by those who have studied his life. He only published one scientific paper, the rainfall at Widdrington paper of 1723, but his interests are attested by several pieces of evidence. Thus Sir John Clerk of Penicuik wrote to Roger Gale in 1729, saying: 'He was, it seems, well known to some of our university professors some years ago, and acquired a great reputation for the mathematics, and his knowledge in all parts of philosophy'.⁴ This may, as Macdonald suggested, date back to Horsley's student days in Edinburgh.

Horsley's existing scientific reputation is based on his activity as a public lecturer on science, a role recognised in several recent histories of the spread of science in the eighteenth century.⁵ He was probably giving courses in the later 1710s. Robinson has argued that 'in the absence of surviving newspapers it is not possible to date the first lectures delivered in the north by Horsley, but he probably began to lecture shortly after Jurin [1710–1712, see below]'.⁶ There is also evidence that a short scientific textbook that he wrote, entitled *A Brief and General Account of The most necessary and fundamental Principles of Statics, Mechanics, Hydrostatics and Pneumatics adapted more especially to a Course of Experiments perform'd at Morpeth, in the County of Northumberland*, 'was certainly printed before 1721'.⁷ Newspaper advertisements provide further evidence of several series of lectures between 1725 and his death in 1731: a course on 'Mechanical, optical, hydrostatic and pneumatic experiment', advertised at Morpeth in 1725, was almost certainly by Horsley.⁸ In May 1731 there was a course to be given by Horsley in Morpeth, and this was repeated at Newcastle 'at the request of some gentlemen.' In an advertisement of July 3rd in the *Newcastle*

Courant, he stated 'They will begin in a little time, and be finished in five weeks, if the company think fit to attend five times each week'. On the 31st of July Horsley further advertised 'The course of experiments lately advertised in this paper, begins (God willing) at Mr. Prior's house, at the head of Tuthill Stairs, on Monday, the 23rd of August, at 6 in the evening; when the times of meeting afterwards, and other circumstances, shall be adjusted and settled to the satisfaction of all those that design to attend'.⁹ Finally one should note the sale of Horsley's scientific instruments after his death, again from the *Newcastle Courant*:

To be sold a set of mechanical, hydrostatic, optical and pneumatical instruments late belonging to the Rev. Mr. John Horsley, together or in parcels, on Thursday the 29th of this instant March, at the house of Mr. William Pryer, Newcastle, where the instruments may be viewed at any time within ten days before the sale.¹⁰

These various pieces of information provide evidence of Horsley as a scientific expositor and teacher, but they do not portray him as an *active* scientist, making observations and engaging with contemporary scientific debate and discourse. The 1723 rainfall paper is his sole original, published contribution, and it is precisely here that the Royal Society correspondence with James Jurin and Horsley's weather Registers can throw fuller light on John Horsley's scientific observations and the context of the *Philosophical Transactions* paper.

JAMES JURIN

James Jurin's life and scientific career has been described in detailed by Rusnock in her prefatory essay to the edition of his correspondence, and only a brief outline, emphasising his North East connections, needs to given here.¹¹ Jurin was born in London in 1684 and educated at Christ's Hospital and Trinity College, Cambridge, where, under the influence of Richard Bentley the Master of Trinity, he became a keen follower of Newton. In 1708 he became a Fellow of Trinity, and in 1709 Head Master of the

Grammar School (now the Royal Grammar School) in Newcastle upon Tyne. Jurin had gained the headmastership on the recommendation of Richard Bentley, but the move to Newcastle did not simply spring from the random availability of a suitable appointment, for Jurin had family roots in the region. His mother Dorcas was a Cotesworth, sister of the successful London physician Caleb Cotesworth.¹² Caleb and Dorcas were siblings of John Cotesworth of the Hermitage (north of Hexham), a prominent saltpan and ship owner who was high sheriff of Northumberland in 1724.¹³ In turn, the three were first or second cousins of William Cotesworth, 'Black William', the leading coal owner and business venturer.¹⁴ While in Newcastle, Jurin wrote a revised edition of Varenus' classic text on physical geography *Geographia Generalis*, and gave several subscription lecture courses on scientific subjects. Lecture courses by Jurin were advertised in the *Newcastle Courant* in 1711 and 1712, and the detailed outline of a course on mechanics has been reproduced by Robinson.¹⁵

Like John Horsley and several others of his era, James Jurin combined scientific with antiquarian interests, though in very different proportions to Horsley. Whilst living in Newcastle, Jurin had undertaken a tour of the Roman Wall country in 1713–14, and collected several inscriptions, sending details to Bishop William Nicholson in Carlisle.¹⁶ Indeed, one of his first publications in *Philosophical Transactions of the Royal Society* was a note of an inscription near Castlesteads mentioning the Catuvelauni,¹⁷ and Horsley himself noted 'It was first published by Dr. Jurin'.¹⁸ This interest did not die after he left the north, for Robert Cay of Newcastle was sending him copies of inscriptions for comment as late as 1725,¹⁹ though there is no record of any correspondence between Horsley and Jurin on these matters.

Jurin's period in Newcastle seems to have been cut short by disputes with the city council, certainly over the charging of school fees and possibly over political differences.²⁰ Black William's two boys attended the Newcastle Grammar School during Jurin's headmastership, but

when Jurin left in 1715, Cotesworth subsequently withdrew the boys in Easter term 1716, transferring them to Sedbergh. On 25 January 1715/16 Henry Liddell had written to Cotesworth

Your Town was unworthy off so honest a man as Jurin as you very well remark. Posterity will have occasion to curse those who have had any hand in making him uneasy in ye Post he was possess'd off. But what can be expected from such a sett of governors and to be succeeded by such a Wretch who is not worthy off wiping his shoes is no less admirable.²¹

Leaving Newcastle, Jurin moved to Cambridge to pursue a medical degree, becoming MD in 1716. Obtaining such a qualification was expensive, but there is evidence that Jurin saved a considerable sum (estimated at £1,000) from his time in Newcastle. In 1716 he moved to London, establishing both a prosperous medical career and a role in scientific circles. However, his north-east family connections continued to play a role in Jurin's life after he left Newcastle. When Cotesworth's elder son Robert visited London he was told to call on his kinsman Dr. Jurin 'for his conversation must be a great spur to quicken your desire of knowledge and make you endeavour to have a general taste of all things that lie in your way which may make you acceptable in the world'.²² When negotiations took place in 1720–1721 between Cotesworth and William Blakiston Bowes, a leading land and coal owner based at Gibside, over a possible marriage of Bowes to Cotesworth's daughter Margaret, Jurin acted as a financial go-between, and a series of letters from Bowes to Jurin survive.²³ Bowes' attitude was coldly financial, and the negotiations came to nought, but left an enmity between the two parties. In his medical capacity, Jurin also kept his local connections, treating Henry Shafto of Whickham in 1727 and corresponding with his Newcastle physician Jacob Johnson.²⁴ He also treated his cousin Black William. When Jurin married in 1724, his wife, Mary Douglas, was the young widow of a Northumbrian landowner. Although Jurin never lived in the north after 1715, his son (also James and an FRS) inherited (or acquired) the Hermitage from his

cousin Michael, but his occupation was short-lived for he died in 1762.²⁵

In London Jurin flourished in both scientific and medical circles. He was elected a Fellow of the Royal Society in 1718, and published numerous papers in *Philosophical Transactions* between 1717 and 1723. From 1721 to 1727 he was Secretary, but played a lesser role after Newton's death in 1727, when Sir Hans Sloane became President, rather than Martin Folkes (whose candidature Jurin had supported). Jurin's medical career meanwhile went from strength to strength: he spent a season each year at Tunbridge Wells treating the wealthy, became physician (and later Governor) at Guy's Hospital and eventually President of the Royal College of Physicians shortly before his death in 1750. His status is attested by his controversial treatment of Sir Robert Walpole for bladder stones, a treatment that was thought to have contributed to Walpole's death.

During his period as Secretary of the Royal Society, Jurin developed an extensive correspondence network, exchanging scientific letters with scholars in both the British Isles and abroad, including the American colonies (such as Cotton Mather in Boston).²⁶ In this he was rebuilding the role Oldenburg had fostered in the Royal Society in the seventeenth century, and it is in this work of gathering and compiling quantitative information, making the Society what Latour has termed a 'centre of calculation', that Jurin's main scientific contribution lies.²⁷ The correspondence covered a wide range of scientific and medical subjects, and the surviving letters have been calendared and edited by Rusnock.²⁸ Within his extensive scientific network, Jurin had two scientific correspondents in the north-east: John Horsley and Robert Cay. These two were close friends. Robert Cay was a salt manufacturer, with pans at South Shields, the Northumberland coast and in Scotland, and he lived in Newcastle and North Charlton (south of Belford). Horsley had known Cay and his brother John since his youth, and Robert Cay was a major help in getting the *Britannia Romana* published after Horsley's death.²⁹ Cay's scientific interests lay

in chemical experiments, and the Jurin correspondence contain several exchanges with Robert Cay. But it is Jurin's correspondence with John Horsley on meteorology that is the more interesting, for it focused on one of Jurin's key projects.

Amongst the correspondence topics, two projects of Jurin's stand out: the assembly of evidence on the effectiveness of inoculation, and the meteorological records. In both cases Jurin used the resources and institutional prestige of the Royal Society to carry forward the ventures. It is worth quoting Rusnock's assessment:

The Society provided crucial institutional support ranging from such mundane, but necessary, matters as covering postage costs to the less tangible factors of legitimation . . . As the coordinator of the correspondence networks, Jurin himself became the guarantor of accuracy and reliability. . . . Jurin's projects represented a new way of doing science, where the correspondence coordinator became a data collector. Similar to Adam Smith's famous pin factory, natural history and natural philosophy were activities that could be improved by the division of labour. Jurin stood out at the Royal Society, not so much as an experimenter, but as a gatherer and manipulator of matters of fact.³⁰

The smallpox inoculation correspondence assembled data on the effects of inoculation, so that Jurin could provide statistical evidence of the benefits of the practice.³¹ This was primarily (but not exclusively) a correspondence within Britain, but the meteorological correspondence was designed and implemented on an international basis.

By the 1720s meteorology was an established field of research within the Royal Society, with several members keeping weather diaries.³² Instruments for measuring the weather were also being improved, such as Hauksbee's thermometer and various designs of rain gauges and barometers. As these became available commercially, they spread from London to scientists and interested scholars across Britain.³³ Jurin's contribution, as it developed during the

1720s, was to assemble a network of observer-correspondents spread across a wide geographical region, including Britain, Europe and the colonies in North America. He then designed a standardised pattern for the recording of temperature, pressure, wind direction and speed, and also tried to coordinate the instruments. Thus in 1725 and 1726 he persuaded the Royal Society council to fund 18 of Hauksbee's thermometers (the most widely used in Britain) to be sent 'as gifts, to particular Observers, especially in more distant regions'.³⁴ As McClellan has noted, Jurin's project was 'a significant innovation in the pattern of inter-institutional relations and a major step forward in the elaboration of the system of scientific societies'.³⁵

THE HORSLEY-JURIN METEOROLOGICAL CORRESPONDENCE

Reading surviving caches of historical letters is often akin to catching fragments of conversation as one passes an open window: one usually misses the start and end of the conversation, often only hears one side, and the wind carries away parts of what is said. Here there are eleven letters from Horsley and six replies by Jurin, covering three and a half years in the 1720s, from August 1722 to January 1725/26.³⁶ On this occasion, we have most of the two sides of the exchanges.³⁷ Of Horsley's 11 letters, eight are sent from Morpeth in Northumberland or have no location specified, but three are sent from Widdrington, a village some eight miles from Morpeth. The correspondence between Horsley and Jurin contains exchanges of views and information on a range of scientific and medical subjects,³⁸ but it is only the meteorological content that is examined here. In addition to the Horsley-Jurin letters, the Royal Society archives contain all of the portions of weather Register sent up to London by Horsley, and these have not been studied previously.³⁹ Together they provide almost continuous records from 1 March 1723 to 30 March 1724 and from May 1725 to December 1726. Those

for the first period are recorded at Widdrington and for the later period at Morpeth.

There is no firm evidence of Horsley and Jurin meeting before the letters begin in 1722, though it is hard to believe such meetings had not taken place in the previous decade and several of Jurin's expressions suggest they knew each other well: 'Your affectionate friend' (to Horsley, 5 May 1724) and 'my very good Friend, Mr Horsley' (to Robert Simson, 29 January 1726). Horsley's opening letter of 31 August 1722 suggests such a history:

Mr Cary has been once or twice speaking to me about the Papers which I left with you when last at London. As to which all I desire is that you would give yourself no manner of Concern or Trouble about them, but only allow 'em a Room in any Corner till I either have an Opportunity of seeing you myself, or of ordering 'em into some other Hand.⁴⁰

The letter's content is about the optics of refraction and reflection, as is part of the subsequent letter of 18 November 1722.⁴¹ But, in this second letter from Morpeth, Horsley then turns to his main information:

But I have said so much on this Head that I am afraid I have scarce left sufficient Room for what I intended should be the principal Contents of this Letter, and that was to give you some short Account of the violent Wind we had here on Tuesday the 6th of this month, and the Fall & Rise of the Mercury upon that Occasion.

Horsley's letter provides a detailed account of the passage of a deep weather depression (though that term was not current then). The day was somewhat unsettled, but gave him no particular disquiet:

Some time before Dinner (how long I cannot exactly remember) I observed it to be somewhat cloudy, windy & Rainy (tho' not much so) and thereupon went to look at the Barometer, and at that Time I found the Mercury a Degree below Rain, or at 28.9 Inches.

The weather continued much the same, but, 'about Four in the Afternoon', Horsley noted something odd in a cylindrical glass he had 'standing upon my Study Window before me'.

In the cylinder, filled with water, Horsley had thin bladders or 'images' floating, probably as a device to view specimens. One of these had been made rather too heavy and had sunk to the bottom and Horsley had left it there 'for about 20 Days . . . I either wanting Inclination or Leisure to change the Water and rectify the Image'. This bladder had now risen to the surface and Horsley drew the inference that 'the Gravity of the air and so the Pressure on the Bladder was considerably diminished'. He now looked at his barometer again, found it fallen to 28.4 and recognised a storm was coming: 'Upon this warn'd our People of an approaching Storm, and prepar'd myself to the best Observations about it I could'. The fall continued as he observed it each half-hour and by 9 in the evening it was down to 27.95 and then began to ascend again. He calculated that it 'seems to have fallen at a Rate of 1/10 of an Inch in an Hour, and that almost in a uniform Regular Manner'. The next morning, Horsley recorded the rise back to 29 inches, and by the Thursday 'the Image sunk again to the Bottom' of his glass cylinder.

During the passage of this depression Horsley observed that

The Sky was pretty clear and little or no Rain fell all of the Time. The Thermometer was at 60 in the Middle between Frost and Cold. The Wind was Westerly inclining somewhat to the South, but did not seem to me to rise to such a Height as I fully expected, nor was it so high here as it seems by the Relations I have had, to have been at Newcastle and somewhat more to the South. Perhaps we might not be so sensible of it, because the House was fenced with Trees on that Side. For it was strong enough to bring down a Stone Chimney which standing pretty high & above the Fence of the Trees, was more exposed to the Shock. This happened between Eight and Nine when the Wind was at its highest; and falling directly above our Heads did which its terrible noise & not a little affright & alarm the Family.

The account shows Horsley's possession of, and careful attention to, a barometer, and goes on to reveal Horsley crouched more closely over his barometer, looking at tiny air bubbles emerging from the falling mercury. Subsequent

letters reveal he also possessed a Hauksbee's thermometer and designed his own rain gauge.

This letter was important. When Jurin replied on 26 February 1722/23,⁴² his letter contained the very first mention of his meteorological project:

I receiv'd the favour of yours dated Novr. 13th in due time, part of which relating to the Storm, I communicated some time after to the Royal Society, who have order'd me to return you their thanks for the account. The Misfortune is we receive this kind of Observation but seldom, & they generally come single, that is from one Observer only; whereas if we could have frequent accounts of them & those from different Persons. seated at proper distances. over a great Extent of Country, we might in time come to a great many particulars concerning the Progress, & probably the Origine of Winds, upon which the changes of Weather seen in great measure to depende, which at present are involved in great Obscurity for want of such Observations made in sufficient numbers. I hope by degrees to establish a Correspondence particularly for this purpose, & shall be very glad if you will make one of the Number, & transmit your Journal regularly to me once in a quarter or half year expressing at least once every day the height of the Barometer & Thermometer, the Wind and something of the Weather, with particular Observations on Storms after the manner of those contained in your last.

It may well be that John Horsley's careful barometric recording of the passage of the storm was the stimulus to Jurin taking up the project. This is not to argue that the idea was not one Jurin had already contemplated – Jurin was himself a keen meteorological observer – but the reply to Horsley is the first mention of the project, and he followed it up by letters to Robert Simson in Glasgow on 5 March and then to Richard Dobbs in Dublin on 15 June.⁴³ Jurin subsequently took the idea to the Royal Society, drafting a letter of invitation to take part in the network. This was presented in Latin for an international audience,⁴⁴ and it was the following winter of 1723/24 that the main batch of invitations was sent out by Jurin. As well as

Table 1 Extract from Horsley's Widdrington Register for March 1722/23 [RS Cl. P. V. 20]

March [1723]		Therm	Baro	Wind	Weather
21	7	55	30	S.E. 1	Thick Air
	1	53	D°	E 3	Clearer
	9	D°	29.91	D°	Clean, sharp Air

from England and Ireland (with Scotland backward in generating willing observers), meteorological observers were engaged across Europe in Uppsala, St. Petersburg, Berlin, Leyden, Naples, Luneville, and in the American colonies at Boston.

Horsley was quick to respond to Jurin's first airing of the idea of a network of observers, and by 2 April 1723 he was writing again. This letter is the first of a sequence of three sent from Widdrington, and Horsley clearly spent some time there. He expressed his enthusiasm:⁴⁵

Your obliging Letter dated February 26 came safe to my Hand. I shall be very willing to be one of your Correspondents and ready at any Time to contribute any thing I can towards the carrying on the equally pleasant and useful Design in which you are engaged. The Register I had kept at Morpeth is unhappily lost or mislaid, but I shall now begin again with what Care and Exactness I can, and according to your Desire transmit a Copy every Quarter or every Half year at farthest.

Horsley then set out the format he planned to use in his recording:

And I have sent you inclosed a Specimen of the Method in which I intend to proceed. If you think it proper that there should be any Additions, Alterations, or Amendments therein, I should be glad to receive your Directions about it.

The inclosed will I think require no Explication. I make use of Mr Hawksbee's Thermometer which beginning at Extream Heat reckons 90 Degrees to Extream Cold, and so places Temperate Air at 45. I divide the Wind into 4 Degrees; 1, 2, is a Sensible Wind; 3, 4, a Fresh Gale; 5, 6, a Strong Wind; 7, 8, a Storm or Hurricane. One side of my Register Book I reserve clean & entire for such Remarks (either as to Fact or Theory) as occur to my Knowledge & concern Physiology. . .

The letter then contained some examples of these notes, such as

Miscellaneous Remarks and Occurrences for the Month of March. The Ways in the Beginning of this Month were generally very dry and good. The Ague Epidemical. On the 13th a large Quantity of Rain fell at a few miles Distance to the West and South West.

Horsley's 'Specimen of the Method' survives in the Royal Society archives as a sheet annotated 'Mr. Horsley, Widdrington Castle, Northumberland', and provides his record for the month of March 1722/23.⁴⁶ Table 1 provides a brief extract, the entry for 21 March. He also had a whole year of rainfall measurements already to hand. These he reported in the second part of the letter: 'I have kept an exact Account of what Rain has fallen the last year in this Place, which I have here sent you'. In the letter he also explained the design he had used for his rain gauge:

The Weighing of the Water and reducing it from Weight to Depth seem'd pretty troublesome, even when done by the easiest Method: to remedy this Inconvenience (besides a Funnel and proper Receptacle for the Rain) I use a Cylindrical Measure and Gage. The Funnel is 30 Inches Diameter, and the Cylindrical Measure exactly 3; the Depth of the Measure is 10 Inches, and the Gage the same Length, with each Inch divided into 10 equal Parts; or, instead of a Gage, the Inches and Divisions may be mark'd in the Side of the Cylindrical Measure. The Apparatus is simple and plain, and it is easy to apprehend the Design and Reason of the Contrivance; for the Diameter of the Cylindrical Measure being just 1/10 of that of the Funnel, and the Measure exactly 10 Inches deep, 'tis plain that 10 Measures of Rain make an Inch in Depth; one Measure, 1/10; one Inch on the Gage, 1/100; and 1/10 of an Inch on the Gage, 1/1000, &c

Horsley then provided his rainfall record for the previous twelve months:⁴⁷

By the following Account you'll see, that some of the Summer Months, particularly May and July, were very wet, and some of the Winter ones very dry; so that, one with another, this year's Rain, as far as can well be conjectur'd, may be look'd upon as a Medium. And if so, it differs not above two or three Inches, from the Quantity of Rain which falls at Upminster, Paris and Lisle [Lille], being less than at Lisle, and more than at the other two Places.

An Account of the depth of Rain fallen from April 1, 1722, to April 1, 1723

	Inch
In April	1.015
In May	3.532
In June	2.570
In July	4.350
In August	2.132
In September	1.155
In October	.600
In November	2.205
In December	1.780
In January	1.225
In February	.485
In March	.195
In the whole Year	21.244

This section appeared in *Philosophical Transactions* the same year, and Jurin's reply of 4 May signals the Royal Society's recognition of the rainfall record, and refers to Horsley's specimen of his weather Register:

Your letter of the 2nd April was very acceptable as well to myself as to the Royal Society, to whom it was lately communicated, & whose thanks for it I am ordered to return you.

Your Method for measuring the quantity of falling Rain is as simple, easy, & exact as can be desired; & the Specimen of a Journal you have sent me, is such, as, I think, cannot be alter'd for the better. I only beg, that you will every where set down the Letters & Numbers themselves, even where they are to be repeated for the next Observation, the word D^o [Ditto] which you sometimes use, creating a doubt now & then, especially in the Column of Winds, whether or no the preceding number for the strength of the Wind, be designed to be repeated, as well as the Letters expressing the point of the Compass.⁴⁸

In his subsequent Registers Horsley followed Jurin's advice and avoided the use of D^o. Horsley's next communications, printed by Rusnock, are mainly concerned with non-meteorological matters, the first with Thomas Brown's double vision and the second with Horsley's ideas on curvature.⁴⁹ But they do contain updates on the Horsley's Register. The letter of 1 July 1723 notes 'Yours of May 4th I received which was very acceptable & very obliging, and what you desire in it shall be done when I send you my Register', and that for 16 July 1723 'I am carrying on my Register with what Care & Exactness I can, which you may command whenever you please, tho' I think it will be full large to send by the Post'. He then added 'We have had a very dry Season with us, tho' I find it is not peculiar to us. Since the Beginning of February to this Day which is Five Months & a Half we have had little more than 3½ Inches of Rain, which is very surprising, being less than less by ¾ Inch which we had in the single Month of July 1722'.⁵⁰

In his reply of 19 October 1723, Jurin was keen that the Register be forwarded:

We are very much obliged to you for the care you take in your Register which may be sent, if you please, at the end of the year, either by the Coach, or by any Friend, that is coming up. Our Season here has likewise proved very dry as with you.⁵¹

One of Jurin's enduring concerns with the whole meteorological project was that initial enthusiasms to take part soon withered, and his letters to many correspondents are chivvying in nature. However, Horsley did deliver, as his next letter indicates. Writing on 13 February 1723/24, he reports that he has found a way to send his weather register:

I have sent up a Copy of the Register by some who are gone to be witnesses in our controverted Election. They have promised to deliver the Papers safe to your Hand, and I believe will be as good as their Word.⁵²

He then discussed the problem of ice forming in his rain gauge during the Northumbrian winters:

Table 2 *Extract from Horsley's Widdrington Register for July 1723 [RS Cl. P. V. 21]*

July [1723]	Therm	Baro	Wind	Weather	Rain
23	7	35	S 1	Very warm and close	
	12	34	E 4	Clear Sunshine	
	8	33	SSE 2	Warm & pleasant, little cloudy	
24	7	35	ESE 5	Rain last night, now cloudy	.098
	12	32	SE 5	Beginning to rain	
	8	31	S 4	A violent Shower, now fair	.250
25	8	34	SW 4	Rain last night, now fair & cloudy	.055
	1	33	WSW 5	Drops of Rain, now Sunshine	.005
	9	31	S 2	Clear & pleasant	
26	8	33	SSW 3	Warm and clear	
	12	32	E 2	A shower or 2, now fairly warm	.028
	8	31	NE 2	Thunder & some rain this afternoon	.075

I never had any Trouble with Ice till the other day, and then I found it really made no Alteration. For braking it, I poured it with the Water into the Measure, and taking my Gage from the Surface of the Water, 'tis plain that the Ice swimming in the Middle would by the Laws of Hydrostatics neither increase nor diminish the Measure of Water. And (as I never suffer the Water to continue at any time to evaporate) I make use of a Receptacle for the Rain which is not as usual very close at the Top; so as that the Ice may be safely broken, and passed out when broken in Pieces.

This Register covered the period April 1723 to January 1723/24, and was again recorded at Widdrington.⁵³ The format was as before, but with the inclusion of daily rainfall totals. One notable feature of the Register is the frequency of recording, often three times a day, as in the extract in Table 2. Attached to this Register was a note by Horsley, providing further detail about his measurements. He had placed his thermometer 'in a large Room on the West Side of the House, which is pretty much shaded with Trees. It stands between two Windows in such a Manner that the Sun can never shine upon it at all'. His efforts to set his barometer correctly are certainly praiseworthy:

The Barometer, which is of the Portable Kind is set just beside the Thermometer. I try'd to take the Level from the High Water Mark ... [?] ... Place where it stands, but quickly found my Instrument cou'd not be rely'd on.

However, the Barometer was carried down to the full Sea Mark which is about a Mile from the House, & the Mercury stood there about a Degree & a Half (or 0.15 Inch) higher than it did in my Room, both before and after our Return. From whence I concluded that my Barometer is placed about 40, or 45 Yards above the high Water-Level. It would not be amiss to do the same in other Places with other Barometers where it could be done with ease & convenience.

Horsley's notes on his rain gauge reveal its actual location:

The Funnel for receiving the Rain is about two Foot deep exclusive of the Spout & made sloping, so as that there seems to be no Danger of any Loss by the Rebound of the hastiest Showers, or even of the most violent Hail, & being placed at a corner of the highest Leads above and remote from all other Buildings with its Brim about two or three Inches higher than the Top of the Battlement, it is not possible a Drop of Rain should be intercepted.

The rain gauge was thus not simply located in the village of Widdrington, but on the battlements of the Widdrington Castle itself.⁵⁴ Horsley noted that 'to prevent any Loss by Evaporation the Rain is all ways taken and measured immediately after its Fall if it fall in the Day & if it fall in the Night it is taken and measured as soon the next Morning'. This allowed him to see if there was any close relationship between the rainfall and the passage of

depressions: 'that it may appear by the Register what Quantity falls at every particular Time which shows that there is no regular Proportion between the Degree of the sinking Mercury, & the Quantity of falling Rain'.

At about the same date as he received this weather Register from Horsley, Jurin was sending out copies of his formal invitation to contribute to the meteorological network, which included a specimen Register. On 18 February 1723/24, he had sent Robert Cay copies for onward transmission to John Horsley and to Professor Stewart in Edinburgh,⁵⁵ and on the 25th Cay replied:

I received your Papers; & have deliver'd one to Mr Horsley & sent another to Mr Stewart at Edinburgh; but the other two, I'm at a loss, how to dispose of. If you have not already fix'd a Correspondence in Cumberland, I wou'd send One to a Friend at Whitehaven: & (if it be possible) I'll perswade Some or Other, among the Mountains of Alston moor, to keep a Register: for I fancy one kept there, & one on each Sea-Coast, must afford some thing very Curious, when compar'd. . . . Mr Horsley presents his Service and Thanks.⁵⁶

Two months later, in April 1724, Horsley had more to send:

I have sent you inclosed the Remainder of the Register for the last Year ending with the last Month. It is continued in the same Form with the other I sent you before, and which I hear you have receivd. For the future I shall conform my Self more exactly to your form (?) which one I have had from Mr Cay, for which I thank you. I suppose the Form is the exact Copy of your London Register for that Time which made me wish for some more of it. For when I had the Curiosity to compare it with mine here, I had also the Pleasure to observe some things that seemed to confirm Dr. Halley's Hypothesis, tho' that might be determined with much greater Certainty, where there is a greater Number of Registers that have been kept at different Places, which advantage can fall into no better Hands than your own.

I generally take Care to record any Observations of the Wind (as to the Point or Degree) if considerable, as soon as I observe it, that so

the Time of it's Changes & Motion may be known with greater Exactness.⁵⁷

This Register, for January to March 1723/24 at Widdrington, is again in the Royal Society archives.⁵⁸ Horsley's letter shows that he had received a copy of Jurin's formal invitation, with its specimen Register. However, Horsley had misread the intention: it was not an 'exact copy of your London Register', which Horsley could make comparisons with, but a fictitious example, as Jurin made clear in his response of 5 May: 'That part of a Journal put into my Invitation was fictitious & only design'd for a pattern'.⁵⁹ Horsley's letter went on to discuss the structure of his rain gauge and the problems encountered:

I find in measuring the Rain it is not proper to use a Cylindrical Measure of Tin, because it is easily bended & apt to grow in a little Time concave at the Bottom. I believe Glass with a Brass Bottom would be best, if the Proportion can be observed with equal Exactness. I also find that more is requir'd sufficiently to wet the Funnel or in order to transmit any Rain to the Receptacle than I could well have imagined. For which Reason the Funnel should be made of such Matter & in such a manner as to transmit the Rain the most easily & most readily, and the Receptacle be placed immediately under the Funnel.

It seems also convenient in Winter Time to have a loose Cover for the Receptacle with a narrow opening for transmitting the Rain, and so in Frost the Cover may be taken off, and the Ice be broken & poured into the Water.

To this Jurin agreed:

The care & pains you take about your Register is extremely obliging, & I am entirely of the same mind with you in what you propose about the substance of the Funnel. Wood is certainly not so well, on account of the quantity of Rain, that it imbibes. Ours at Crane Court is lined with Lead and the Measure is of Copper: but for this last Glass may do very well, if its capacity from distance to distance be found by actually filling it with given quantities of water & marks be made upon the glass with a Diamond or small File, correspondent thereto. But I need not give you any directions.⁶⁰

Table 3 Extract from Horsley's Morpeth Register for November 1725 [RS MA.47]

Nov [1725]		Therm	Baro	Wind	Weather	Rain
14	6 PM	58	30.35	SW 1	Clear & Fair	
15	9 AM	58	30.25	W 1	Small Rain	.2
17	6 PM	54	29.70	W 1	Misling	
18	9 AM	53	29.60	W 1	Thick Fog	.250
20	5 PM	52	30.10	NW 1	Clear & Fair	

Horsley's next letter of 22 May concerned curvature and the eclipse,⁶¹ and it was not until the following February 1724/25 that he returned to weather themes. Things had not gone smoothly, as he reported after congratulating Jurin on his recent marriage:

I ought before this Time to have sent you my Register, but to tell you the Truth I have none to send you. For my Landlord who was by Agreement to build me a Study where I designed to place my Barometer etc has kept me all this Time in Suspence & Confusion, tho' it was to be done immediately upon my coming into the House. I am the more uneasy at this because by looking now and then at the Barometer, I thought I observed a more than ordinary Variety in it. Particularly the Mercury was once sunk to 28 Inches, and yet I could not say we had anything of a Storm here, tho' upon Enquiry I found that there was at that Time much Wind & Rain at no great Distance. Last Tuesday (the 2nd of February) I observed the Barometer to be higher than ever I had seen it before, the Mercury standing at 30.45 Inches, the Wind Nor-East and rather higher at two Degrees, yesterday it was still somewhat higher, the Wind South East and not above one Degree. This Day it is again a little higher - Mercury being more than 30½ Inches high, the Wind continuing the same. And all this Time we have had cloudy Weather and sometimes raining or misling, tho' now it is somewhat clearer.⁶²

Jurin's reply, mainly concerned with other topics, shows his chagrin at the lack of the Register:

The want of your Register is a great disappointment. I could wish you would for the future observe the heights of the Barometer & Thermometer, with the Wind & Weather, tho'

you let alone the acct of the Rain till your conveniences are fix'd.⁶³

Horsley's following letter was concerned with non-meteorological matters,⁶⁴ but the next did report sending up a further Register, albeit imperfect:

I have here sent you my Register since the 5th of May. It is in some Places imperfect & defective, but such as it is I have ventured to transmit it to you.⁶⁵

This Register, for May to December 1725, gives Horsley's weather records for Morpeth.⁶⁶ The observations are daily, but there are occasional gaps and the readings are not as frequent as the earlier Widdrington records, for there is usually only one reading a day taken at the beginning or end of the day. Table 3 provides a short extract. Horsley's letter to Jurin continued:

I often drank to your Health lately with Mr. Robert Simpson Professor of Mathematics at Glasgow, Who was often blaming himself for not having wrote to you. But the Reason he says was, that he neither could as you wish get any other Person to keep a Register exactly, nor have the Opportunity of keeping one himself to your and his own Satisfaction. I intend to set out for Glasgow tomorrow, having been drawn in to attempt a Course of Experiments there, tho' when the matter is come to a Point, I find the Encouragement far short of what I expected and scarcely worth any Acceptance. I know not but a Line from you to Mr Simpson (if it was not too much Trouble) may it be of some Service, and I know it would be very agreeable to him who is very friendly to the Affair.

Jurin's replied:

I receiv'd yours two days ago, with your Journal for part of the last year, which will be

of good use to me. Be pleased to continue to send me at the end of every year what Observations you have made, whether the Journal be complete or not, only taking care to distinguish such Months, in which you have not measur'd all the Rain that falls. I find too many Gentlemen discouraged by their not being able to keep a constant regular Journal, who therefore will make no Observations at all, whereas an interrupted Journal would many times be of the same use to me as if it were perfect, especially if any Observations happen to be made on Stormy days. I hope you may procure me some Journals to be kept in Scotland, at least I promise my self you will endeavour it, as well for your service of philosophy, as to oblige . . . your faithful friend & very humble servant
PS I write to Mr Simpson, as you desire, by this Post.⁶⁷

Jurin was as good as his word and did write to Simson [Simpson] by the same day's post.⁶⁸ This is the last letter from Jurin in the surviving Horsley-Jurin correspondence, but Horsley had one more portion of weather register to send. This was for the twelve months January to December 1726,⁶⁹ and he sent it from Morpeth on 9 February 1726/1727 with the note:

I have sent you my Register for the last Year. My Absence from Home may have occasioned some little irregularity, but I believe none that material. I gave my Book to a Schoolmaster to transcribe the Register out of it, but he has done it very awkwardly and very indifferently. And I am afraid it would be too late, should I keep it till I got it better transcribed.
I find the Rain last Year comes nearly to what upon the first Trial I guessed might be the mean Quantity here viz. 22 Inches. For the Amount of Rain for all the Months is just 21.723. tab

Here Horsley demonstrated precisely those quantitative scientific skills that Jurin prized: he not only measured the quantity of rainfall daily and calculated monthly and annual totals, but also observed the pattern from year to year. For his first report (April 1722 to March 1723), the annual total was 21.244 inches; in his letter of 16 July 1723 he noted how dry the year was proving, and a later Register provided the annual total for 1723–4 as 15.266 inches. Now

the total for 1726 (admittedly for Morpeth rather than Widdrington) could be seen as 21.723, close to what he 'guessed might be the mean Quantity here'.

Jurin lost the Secretaryship of the Royal Society in 1727 and, although the meteorological project outlasted him, it rapidly lost momentum once he had gone. William Derham collated some of the findings in *Philosophical Transactions*, but the main legacy lies in the weather registers, including Horsley's, still in the Royal Society's archives. But the project, with its emphasis on a careful geographical network of observers and standardised instruments and recording, was recognised as a pioneering and model venture in the development of meteorology, and also a very significant example of international scientific cooperation.

A RIVAL METEOROLOGIST IN MORPETH?

An interesting discovery, unearthed during the search of the Royal Society papers for Horsley's weather registers, provides a tail-piece: a second set of weather records for Morpeth sent by a different correspondent. This person was Mordecai Cary (1687–1751), a lifelong friend of James Jurin. They had been at both Christ's Hospital and Trinity College together and Cary travelled to Holland with Jurin in 1709.⁷⁰ An Anglican clergyman, Cary was headmaster of Morpeth Grammar School from 1718 to 1724. In 1722 he became perpetual curate of Jarrow and Heworth, though still retaining the Morpeth post for over a year, later holding bishoprics in Ireland (Clonfert in 1731 and subsequently Cloyne and Killala).⁷¹ Cary's first 'Diary of Weather at Morpeth in 1722', with readings for the last three months of 1722, was sent to Jurin on 13 January 1722/1723, and the second for 1723 was sent 19 June 1724.⁷² We thus have the remarkable parallel of two clergymen (one Anglican, one Presbyterian), both schoolmasters, both friends of Jurin, both working in Morpeth, and both keeping weather records. The two men undoubtedly knew one another, and were

friendly acquaintances; Horsley's first letter to Jurin began 'Mr Cary has been once or twice speaking to me about the Papers which I left with you when last at London'. It is likely that the two men encouraged each other with enthusiasm for the weather, and there may also have been rivalry, the extent of which we cannot tell, or it may all have been very cooperative.

Cary's first diary dates from shortly after Horsley's initial correspondence with Jurin, but it was Cary who first sent Jurin an actual weather register. However, there is no record of any other correspondence between Cary and Jurin in this period, and a later correspondence in the 1730s was purely concerned with Mrs Cary's health and with discussion of classical authors.⁷³ There is no evidence, other than the two weather diaries, that Cary had scientific interests, and Jurin would certainly know his friend's knowledge and talents. Cary's weather registers themselves are less comprehensive than Horsley's: Cary records temperature, pressure and weather description, but no rainfall measurements or wind directions. He must have been severely shortsighted, for he excused his neglect of wind direction: 'I cannot see a Fane [weather vane] if it be ten yards high, and besides we have none'. Cary does not seem to have been asked to participate in the Royal Society network, which may just be a reflection of his movements in 1723–24, and the letter accompanying his 1723 diary notes 'Part of it was carried on by my brother'.⁷⁴ But it may also be that Jurin recognised Horsley's superior scientific qualities and motivation, and Cary provided neither the quantitative measures of rainfall nor the careful accounts of weather processes that distinguished Horsley's register from many others of the period. Nevertheless Cary did use his thermometer and barometer carefully and his weather comments for Morpeth correspond to Horsley's for Widdrington where the diaries overlap, as they do for part of 1723. Thus for the evening of 24 July 1723 Horsley noted 'A violent shower, now fair' and Cary 'Much rain, wind 3 almost a hurricane'; the next evening Widdrington was 'clear and fair' and Morpeth 'calm fair weather'.

CONCLUSIONS

The Horsley-Jurin correspondence and Horsley's weather Registers allow a fuller picture to be drawn of John Horsley's scientific interests and work. The 'Widdrington rainfall register' can now be seen as part of a wider engagement with weather recording and processes, and one element in Horsley's involvement with a national and international scientific project. At the very least, he was one node in Jurin's extensive network. Indeed, his careful study of pressure changes during a storm in 1722 was probably the trigger for Jurin to get the notable project under way.

John Horsley was elected a Fellow of the Royal Society on 8 May 1729. Sir George Macdonald and other scholars have emphasised that 'There is little or no doubt that the honour was conferred on him in recognition of his acknowledged distinction in archaeology' and, referring to Horsley's scientific lecturing, that 'Latterly, at all events, he must have regarded science as mainly a bread-and-butter subject'.⁷⁵ Certainly his antiquarian correspondent Roger Gale, Treasurer of the Royal Society, was one of his proposers. But perhaps the election was broader in its justification, for the other three proposers were James Jurin himself, his successor as Secretary, the physician William Rutt, and John Eames, friend of Sir Isaac Newton. It is likely that both Horsley's Roman antiquarian scholarship and his scientific interests (including his meteorological recording) contributed to his Fellowship election.

Moreover, Horsley's antiquarian and scientific work showed parallel qualities of careful observation, recording of evidence and cautious inference. In a recent study of William Stukeley, Haycock has drawn an explicit comparison between Stukeley's speculative prehistory (which he sees as rooted in an attempt to integrate with the religious strands in Newtonian philosophy and science) and Horsley's 'more cautious – and in the long run more reliable' scholarship: 'both in attitude to the ancient past, methodology and subsequent reputation, they were very different historians'.⁷⁶ Horsley the careful recorder of Roman

inscriptions is also Horsley the careful meteorological observer and recorder.

The letters and weather Registers not only provide evidence of Horsley's scientific contribution, but they also give us a more rounded portrait of Horsley the man. To the standard pictures of Horsley on horseback visiting Roman sites or sitting in his study writing his *Britannia Romana*, we can add glimpses of the man out in the Northumbrian winter, climbing to the top of the battlements of Widdrington Castle and breaking the ice in his rain gauge, or crouched over his barometer in his study, watching tiny bubbles of air break out of the mercury as the wind blows overhead and the chimney topples, or carrying his barometer down to the beach at Druridge Bay near Widdrington to set his mercury scale.

APPENDIX: WIDDRINGTON AND HORSLEY'S DOPPELGÄNGERS

Horsley's weather recording at Widdrington, some eight miles away from Morpeth, has puzzled previous writers. Based on the assumption that he must have resided at Widdrington for a time, nineteenth-century historians, including John Hodgson and Alexander Gordon (author of the *DNB* essay), drew the inference that the antiquarian cleric was the same person as John Horsley, land agent of Widdrington. This identification was disproved fairly conclusively by John Crawford Hodgson in his 1918 paper, where he provided evidence of the land agent's separate identity, his activities, his death in 1726 and the probate on his estate.⁷⁷ Sir George Macdonald was even sceptical of Horsley's residence in Widdrington at all:

Morpeth is eight miles away, and it is almost incredible that the minister and schoolmaster should have been content to reside so far from his daily labours. It may be urged that the idea that he did so receives substantial support from the fact that it was of the rainfall at Widdrington that he kept a record in 1722–23. After all, however, if he thought Widdrington the best spot at which to set up his gauge, it

would be a simple affair to ride over periodically and make the necessary observations. At a pinch the figures could be taken for him by a friend, for the great merit he claimed for his invention was the ease with which anyone could read it.⁷⁸

The Royal Society letters help somewhat to resolve Horsley's movements. The three letters written from Widdrington cover the dates April to July 1723, suggesting at least temporary residence there, rather than mere horseriding outings. However, the other letters, before and after that period, are written from Morpeth. Moreover, Horsley's weather Registers for Widdrington run from March 1722/1723 to March 1723/1724, the rainfall measurements from April 1722 to April 1724, and his Register letter of 1724 suggests he was living close to or at Widdrington Castle. His twice or thrice daily recording suggests that, even with some assistance, he must have been based at Widdrington for much of his time. One possible (but not entirely convincing) reason why Horsley may have resided for some time at Widdrington is hinted at by a piece of evidence noted Gordon in his *DNB* essay: according to Dr John Evans' 'List of dissenting congregations 1715–1729',⁷⁹ Horsley was (for at least part of this period) minister jointly at both Morpeth and Newbiggin-by-the-Sea, and must have travelled regularly between the two places. However, Widdrington is not directly between the two places, but lies four miles to the north of the direct road; possibly it may have been a convenient base for a time. An alternative explanation is suggested by a later letter for February 1725 where Horsley explains that his landlord had agreed 'to build me a Study', which was delayed but should have been done 'immediately upon my coming into the House'. Widdrington may have been a temporary base whilst Horsley moved residence in Morpeth. However, with present evidence, neither explanation is compelling.

Despite John Crawford Hodgson's evidence, the identification of John Horsley the antiquarian and scientist with John Horsley the land agent of Widdrington has recently been resurrected by Stewart in his detailed and influential

study of the relationships between Newtonian science and industrial entrepreneurship.⁸⁰ Horsley is one of Stewart's examples of this linkage, with Horsley the scientific lecturer seen as identical with Horsley the Northumbrian agent for the York Buildings Company, an important industrial and entrepreneurial venture which controlled the Widdrington estate. It is thus worth reviewing the evidence cited by Stewart. He concedes that 'There is, admittedly some doubt that the lecturer and antiquary John Horsley was the same as the land agent for the York Buildings Company', but asserts that 'The distinction, however, seems based on a very flimsy argument that I have been unable to confirm with any certainty'.⁸¹ Here Stewart cites Macdonald's 1933 paper, but does not cite the J. C. Hodgson paper of 1918.

Stewart also cites other suggestive evidence. He notes that John Horsley was associated with George Liddell and William Cotesworth, and for this has no less a source than Edward Hughes. Hughes, prefacing an extract from a letter from Liddell to Cotesworth of April 1718, claimed that 'His [Liddell's] friend and informant, it transpired, was John Horsley, the famous antiquary and author of the first history of Northumberland'.⁸² However, it is unclear why Hughes makes this identification, for the letter itself refers to 'Cosen Horsley tells me the Duke of Gordon was at Causey Park',⁸³ and such a reference could not apply to our John Horsley. Neither Horsley nor even 'John Horsley' are such uncommon names that their mention must involve our Horsley, and the point is well made by a later letter quoted by Hughes: '... a Paper that he left with Mr. Horsley who takes cares of his Estate, tho' he is steward to Mr. Widdrington'.⁸⁴ This letter is from 1752, so cannot be our Horsley. Similarly Stewart cites a Horsley involved with proprietors of the fire-engine patent in Bromsgrove, but again this need not be our John Horsley. The ease with which one can find further John Horsleys can be seen by examining the contents of *Philosophical Transactions*, where a paper of 1764 is a letter from a John Horsley, in fact the fourth mate of an East India ship, providing observations on longitude.⁸⁵ Without some definite

evidence countermanding the firm facts set out by J. C. Hodgson, the resurrection of 'Horsley antiquary, scientist and land-agent' is chimerical. John Horsley is quite sufficient a polymath without requiring him also to be a business entrepreneur.

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NOTES

Abbreviations:

RS	Royal Society
Wellcome MS	Wellcome Library manuscripts

¹ J. Horsley, *Britannia Romana*, London (1732).

² The main accounts of Horsley's biography are: John Hodgson, *Memoirs of the Lives of Thomas Gibson, M.D., Jonathan Harle, M.D., John Horsley, M.A., F.R.S., William Turner, M.D.*, Newcastle (1831); John Hodgson Hinde, 'Notes on the Rev. John Horsley', *AA*², 6 (1865), 174-80; Alexander Gordon, 'John Horsley', *Dictionary of National Biography [DNB]*, 27 (1891), 382-3; John Crawford Hodgson, 'Remains of John Horsley the historian', *AA*³, 15 (1918), 57-79; Sir George Macdonald, 'John Horsley, scholar and gentleman', *AA*³, 10 (1933), 1-57; and R. C. Bosanquet, 'John Horsley and his times', *AA*³, 10 (1933), 58-81.

³ *Philosophical Transactions*, 32 (1722-3), 328-9.

⁴ W. C. Lukis (editor), *The Family Memoirs of the Rev. William Stukeley, M.D. and the Antiquarian and Other Correspondence of William Stukeley, Roger & Samuel Gale etc.*, vol. 3 [Surtees Society, 80], Durham (1887), 390.

⁵ Examples are L. Stewart, *The Rise of Public Science. Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660-1750*, Cambridge (1992), 289 and 365-8; M. C. Jacob, *The Cultural Meaning of the Scientific Revolution*, Philadelphia (1988), 145; N. Hans, *New Trends in Education in the Eighteenth Century*, London (1951), 59.

⁶ F. J. G. Robinson, *Trends in education in northern England during the eighteenth century, a biographical study* [Unpublished PhD thesis, University of Newcastle upon Tyne], 293.

⁷ Robinson, *ibid.* 293, citing *Durham Biblion*, 2 (1969), 72–3. The text itself is undated, but Wallis's bibliographic researches date it to 1720: R. V. and P. J. Wallis, *Biobibliography of British Mathematics and its Applications, Part II: 1701–1760*, Letchworth (1986), 107.

⁸ Robinson, *ibid.* 94.

⁹ J. Hodgson Hinde, 'Notes on the Rev. John Horsley', 177–8.

¹⁰ J. C. Hodgson, 'Remains of John Horsley', 69. The collection was acquired by another well-known scientific lecturer, Dr. Caleb Rotheram of Kendal, and the remnants eventually reached Dr. Williams' Library in London. After Horsley's death, his assistant George Mark became a lecturer in his own right, and his work in Newcastle and elsewhere has been examined by F. J. G. Robinson, 'A philosophic war an episode in eighteenth-century scientific lecturing in North-East England', *DN²*, 2 (1970) 101–08.

¹¹ A. Rusnock (editor), *The Correspondence of James Jurin (1684–1750)*, Amsterdam (1996).

¹² Rusnock, *The Correspondence of James Jurin*, 9. Rusnock drew upon the unpublished papers of Dr E. A. Spriggs, who began the Jurin project three decades ago. Michael Totton, a descendant of James Jurin, provided Spriggs with a Jurin family tree he had inherited. Andrea Rusnock has kindly copied this information to the present writer. Documentary evidence is needed to support the pedigree, but there is no reason to doubt the Jurin-Cotesworth link, for 'Black William' Cotesworth regarded Jurin as a cousin and involved him in family affairs, and Jurin's son eventually acquired the Hermitage property of his other Cotesworth relatives.

¹³ *NCH*, 4 (1897), 144–6 and J. C. Hodgson, 'Observations on the pedigree of Cotesworth of the Hermitage', *PSAN⁴*, 1 (1923–4), 262–5. Hodgson's paper corrects the genealogy in *NCH*, which had suggested Caleb and John Cotesworth were brothers of 'Black William' Cotesworth.

¹⁴ E. Hughes, *North Country Life in the Eighteenth Century. The North East 1700–1750*, London (1952); J. M. Ellis, *A Study of the Business Fortunes of William Cotesworth c1668–1726*, New York (1981).

¹⁵ Robinson, 'New trends', 287–92.

¹⁶ Wellcome MS 6145. Both letters are printed in Rusnock, *The Correspondence of James Jurin*, 63–5.

¹⁷ J. Jurin, 'Remarks on a fragment of an old Roman inscription lately found in the North of

England, and transcribed by the curious and learned Dr. James Jurin', *Philosophical Transactions*, 30 (1717–19), 813–14.

¹⁸ Horsley, *Britannia Romana*, 258.

¹⁹ RS Early Letters C.2.54 and C.2.56.

²⁰ See G. Hogg, 'Achievement amidst decay, 1700–1820', in B. Mains and A. Tuck (editors), *Royal Grammar School Newcastle Upon Tyne. A History of the School in its Community*, Stocksfield (1986), 45.

²¹ quoted by Hughes, *North Country Life*, 417.

²² quoted by Hughes, *North Country Life*, 376–7.

²³ The letters are in British Library Add. MS. 40747. See also Hughes, *North Country Life*, 10 and 34.

²⁴ Wellcome MS 6139.

²⁵ *NCH*, 4 (1897), 147–8.

²⁶ See Rusnock, *The Correspondence of James Jurin*, and A. Rusnock, 'Correspondence networks and the Royal Society, 1700–1750', *British Journal for the History of Science*, 32 (1999), 155–69.

²⁷ See M. B. Hall, 'Oldenburg and the Art of Scientific Communication', *British Journal for the History of Science*, 2 (1965), 277–90. For 'centres of calculation', see B. Latour, *Science in Action: How to Follow Scientists and Engineers through Society*, Milton Keynes (1987).

²⁸ The letters run between 1703 and 1749, but most date from the period of Jurin's secretaryship (1721–1727). Here the Royal Society archives contain the letters to Jurin, and his family papers (now copied in the Wellcome Library) contained copies of Jurin's own letters, so both sides of the exchanges are often available.

²⁹ On Robert Cay and his friendship with Horsley, see Macdonald, 'John Horsley', 29–32.

³⁰ Rusnock, *The Correspondence of James Jurin*, 22.

³¹ See A. A. Rusnock, 'The weight of evidence and the burden of authority: case histories, medical statistics, and smallpox inoculation', in R. Porter (editor), *Medicine in the Enlightenment*, Amsterdam (1995), 289–315.

³² For histories of eighteenth century meteorology, see H. H. Frisinger, *The History of Meteorology to 1800*, New York (1977); J. L. Heilbron, *Physics at the Royal Society during Newton's Presidency*, Los Angeles (1983); V. Jankovic, *Reading the Skies. A Cultural History of English Weather, 1650–1820*, Manchester (2000).

³³ See J. Golinski, 'Barometers of change: meteorological instruments as machines of enlightenment', in W. Clark, J. Golinski and S. Schaffer (editors),

The Sciences in Enlightened Europe, Chicago (1999), 69–93.

³⁴ quoted by Rusnock, *The Correspondence of James Jurin*, 29.

³⁵ J. E. McClellan III, *Science Reorganized. Scientific Societies in the Eighteenth Century*, New York (1985), 161.

³⁶ In the transcriptions and extracts here, the original spellings and capitalisations have been retained, but contractions for ‘which’ and ‘that’ have been expanded and ‘ye’ modernised to ‘the’. Horsley is more consistent in his capitalisation of nouns than Jurin.

³⁷ One of Jurin’s replies is missing (and a copy of it may never have been made or kept by Jurin), for attached to Horsley’s letter of 13 November 1722 is an endorsement by Jurin: ‘letter from Mr. Horsley August 31st 1722 on the Force of the Rays of light: Answer’d Oct 13th 1722’

³⁸ In particular Horsley views on curvature, and Jurin’s responses, take up large sections of the letters. Horsley was convinced that curvature could be analysed as an infinitely-sided polygon. Jurin’s response was that, whilst this may be of heuristic value, it could (and would) lead into analytical error and thus Newton himself had cautioned against the perspective. The discussion ran through several letters, and clearly Horsley was hard to dissuade. Horsley’s letters also raise questions of the optics of colour refraction, experiments on glass garnets and of the analysis of glass slivers (where Jurin recommends Hooke’s *Micrographia*, but Horsley says he does not have access to a copy), and the recording of the solar eclipse of 1724. He also sends Jurin details of a case of double vision, when Thomas Brown of Shawdon Hall (north west of Alnwick) was thrown from his horse, debating whether the cause was the eye muscles or the optic nerve, and the strange case of the George Rand of Bedlington, the man who voided two substantial balls of organic matter from the stomach around plum or cherry stone cores.

³⁹ The relevant documents are RS MA [Meteorological Archive] 47, Cl. P. V [Classified Papers 1650–1740, V. The Weather] 20 and Cl. P. V. 21. As noted below, some of the portions are misbound together but the sequences have been unravelled, and all that Horsley sent up to London seems to have survived. During the period 1724–25 Horsley moved house, with some disruption noted in the main text, and no Register was sent to Jurin.

⁴⁰ RS Early Letters H.3.98.

⁴¹ RS Early Letters H.3.99.

⁴² Wellcome MS 6146.

⁴³ Wellcome MS 6146 (Simpson, 5 March 1722/3) and Wellcome MS 6146 (Dobbs, 15 June 1723).

⁴⁴ J. Jurin, ‘Invitatio ad Observationes Meteorologicae communi consilio institutas’, *Philosophical Transactions*, 32 (1723), 213–27.

⁴⁵ RS Early Letters H.3.100.

⁴⁶ This is the last two pages of RS Cl. P. V. 20

⁴⁷ Horsley himself used a comma to denote the decimal point in his monthly rainfall record, as was common practice at that period. Here it has been replaced by a point or stop for clarity.

⁴⁸ Wellcome MS 6146.

⁴⁹ RS Early Letters H.3.101 (1 July 1723) and H.3.102 (16 July). They are printed in Rusnock, *The Correspondence of James Jurin*, 188–9 and 192–5.

⁵⁰ RS Early Letters H.3.102.

⁵¹ Wellcome MS 6146. Printed by Rusnock, *The Correspondence of James Jurin*, 202–03.

⁵² RS Early Letters H.3.103.

⁵³ RS Cl. P. V. 21.

⁵⁴ Widdrington Castle and estate had been forfeited to the Crown after the Widdrington family’s involvement in the 1715 Jacobite rebellion, and in the early 1720s the estate was in the hands of a property company. Bosanquet, ‘John Horsley and his times’, 62–63.

⁵⁵ Wellcome MS 6146.

⁵⁶ RS Early Letters C.2.55. Printed by Rusnock, *The Correspondence of James Jurin*, 229–30.

⁵⁷ RS Early Letters H.3.104.

⁵⁸ This record is bound as the first four pages of RS Cl. P. V. 20, with no year-date provided, but monthly rainfall totals are appended for April to March, and these indicate the detailed record is for January to March 1723/24.

⁵⁹ Wellcome MS 6146. Printed by Rusnock, *The Correspondence of James Jurin*, 244–5.

⁶⁰ *ibid.*

⁶¹ RS Early Letters H.3.105.

⁶² RS Early Letters H.3.106.

⁶³ Wellcome MS 6146 (18 March 1724/5).

⁶⁴ RS Early Letters H.3.107–108.

⁶⁵ RS Early Letters H.3.109 (20 January 1725/26)

⁶⁶ RS MA. 47. Six pages for May to December 1725.

⁶⁷ Wellcome MS 6146 (29 January 1725/6).

⁶⁸ Wellcome MS 6146 (29 January 1725/6), printed in Rusnock, *The Correspondence of James Jurin*, 323–324.

⁶⁹ RS MA. 47, last 10 pages.

⁷⁰ Rusnock, *The Correspondence of James Jurin*, 10.

⁷¹ G. Robinson, *The Story of Morpeth Grammar School*, Morpeth (1951), 54–5.

⁷² RS Cl. P. V. 16 (12 January 1722/23) and RS Cl. P. V. 18 (19 June 1724). The first diary runs from 8 September 1722 to 3 January 1722/23, with some short gaps. The second runs from 6 February 1722/23 to 14 September 1723, but was not sent until nine months later. The last four pages of RS Cl. P. V. 16 also contain a record for 19 January to 16 May, and this is in fact an overlapping record with that contained in the second diary.

⁷³ Rusnock, *The Correspondence of James Jurin*, 505–506.

⁷⁴ RS Cl. P. V. 18.

⁷⁵ Macdonald, 'John Horsley', 10.

⁷⁶ D. B. Haycock, *William Stukeley. Science, Religion and Archaeology in Eighteenth-Century England*, Woodbridge (2002), 6.

⁷⁷ J. C. Hodgson, 'Remains of John Horsley', 76–7.

⁷⁸ Macdonald, 'John Horsley', 11.

⁷⁹ This manuscript list is held in Dr. Williams' Library, 14 Gordon Square, London, as MS 34.4.

⁸⁰ Stewart, *The Rise of Public Science*.

⁸¹ *ibid.* 366, footnote 190.

⁸² Hughes, *North Country Life*, 22.

⁸³ quoted by Hughes, *ibid.* 23.

⁸⁴ quoted by Hughes, *ibid.* 80.

⁸⁵ John Horsley, 'Extract of a Letter from Mr. John Horsley, Fourth Mate on Board the Glatton East-India Ship, to the Rev. Mr. Nevil Maskelyne, F.R.S. dated Batavia, Nov. 16, 1763, Giving an Account of His Observations, at Sea, for Finding out the Longitude by the Moon', *Philosophical Transactions*, 54 (1764), 329–32.