

# Workshop on Mathematical and Astronomical Practices in pre-Enlightenment Scotland and her European Networks

23-24 Nov, 2018, St Andrews

## Programme

### Friday 23 Nov

- 9.00-9.30 Registration
- 9.30 Alison Morrison-Low (National Museums of Scotland): *Surviving scientific instruments from early modern Scotland: a survey*  
Samuel Gessner (Lisbon): *Thinking with instruments and the appropriation of logarithms on the Iberian Peninsula around 1630*
- 11.00 Coffee
- 11.30 Kevin Baker (Oxford): *Practices of Reading the Principia: How contemporaries engaged with Newton's book in the years immediately after publication*  
Olivier Bruneau (Lorraine): *Colin MacLaurin (1698-1746): a Newtonian between theory and practice*
- 13.00 Lunch (*not* included in registration)
- 14.00 Visit to Special Collections to see St Andrews' collection of Medieval and Early Modern mathematics and astronomy books
- 15.30 Tea
- 16.00 Steve Russ (Warwick): *John Napier: the mysterious making of a mathematician*  
David Horowitz (St Andrews): *John Craig (1663-1731)*

### Saturday 24 Nov

- 9.00 Davide Crippa (CNRS): *James Gregory and his Italian readers : beating untrodden paths*  
Pilar Gil (St Andrews): *Building an astronomical observatory in the knowledge community of St Andrews in the 17th century*  
Bruno Almeida (Lisbon): *Mathematics and Navigation: Pedro Nunes' works in England in the sixteenth century*
- 11.00 Coffee
- 11.30 Alex Craik (St Andrews): *George Sinclair on Hydrostatics*  
Jane Wess (Edinburgh): *Colin MacLaurin on Wind and Water: the Local and the Universal*
- 13.00 Lunch (included in registration)
- 13.45 Albrecht Heefer (Ghent): *The difficult relation of surveyors and algebra: the hundred geometrical questions of Cardinael*  
Philip Beeley (Oxford): *'There are Great Alterations in the Geometry of Late': Isaac Newton's early Scottish circle*
- 15.15 Closing discussions

**Abstracts:****Bruno Almeida**

*Mathematics and Navigation: Pedro Nunes' works in England in the sixteenth century*

This paper addresses the contributions of the Portuguese Cosmographer Pedro Nunes (1502-1578) to nautical science and the transmission and diffusion of his ideas to England during the sixteenth century. I will show how important authors such as John Dee, Thomas Harriot and Edward Wright, who were interested in different topics of Nunes' work, such as the theory of rhumb lines (the modern loxodrome), contributed for its transmission. This particular subject interested many mathematicians for more than one hundred years, among them the important Scottish mathematician James Gregory.

**Kevin Baker**

*Practices of Reading the Principia: How contemporaries engaged with Newton's book in the years immediately after publication*

Given its status as a foundational text of modern science, remarkably little is known about how the *Principia* was read when it was published in 1687. Which individuals worked through its notoriously difficult proofs, in what order, to what ends, and when, have never been systematically established. While the origins of Newton's ideas have been the subject of continuous debate for over three hundred years, how early readers engaged with the text, and the means by which its innovative mathematical techniques were validated, have received far less scholarly attention.

My doctoral project explores these questions, and in this talk I will outline my provisional findings. Concrete evidence of reading in the handful of years after publication exists for no more than a dozen individuals, yet even within this small group practices were diverse. We see heterogeneous responses to a *sui generis* text. Readers were generally selective, working through isolated results and sections rather than the whole book. The importance of rigour when assessing the *Principia's* novel, limit-based methods varied considerably; and Newton was remarkably willing to alter the text in response to suggestions of his readers.

Among the *Principia's* most important early readers were two Scots, John Craig and David Gregory. Craig's annotated first edition is now held in the Fisher Library at the University of Sydney, and Gregory's meticulously detailed reading notes are in the Royal Society of London: this latter document represents the best evidence we have that any single individual conducted a complete, Hobbesian reading of the entirety of Newton's text.

### **Philip Beeley**

*'There are Great Alterations in the Geometry of Late': Isaac Newton's early Scottish circle*

This paper will trace the rise of three Scottish mathematicians, Colin Campbell, John Craig, and David Gregory, to become key figures in the dissemination and promotion of Newton's mathematical ideas in the 1680s. Drawing on contemporary correspondence, and previously unpublished papers, it will consider how these men contributed to the scholarly perception of Newton and how conversely Newton used his increasing influence in order to encourage their work, most notably obtaining for Gregory the vacant chair in astronomy at Oxford in 1691.

### **Olivier Bruneau**

*Colin MacLaurin (1698-1746): a Newtonian between theory and practice*

The famous Scottish mathematician, Colin MacLaurin is best known for some formulae and as a proponent of the theory of Fluxions. We seldom consider his works on practical mathematics or his application of mathematics in other parts of knowledge (annuities, gauging, ...). I will point out these applications and I will try to show how we can consider MacLaurin as a "Newtonian in action."

### **Davide Crippa**

*James Gregory and his Italian readers: Beating untrodden paths*

In the catalogue of the National Library of Florence, we can find a manuscript (cc.36r-46r, ms BNCF Galileiano 213) containing a copy of the first 25 pages (approximately) of James Gregory's book *Vera Circuli et hyperbolae quadratura*, printed in September 1667 in Padua. This book is outstanding in the history of mathematics, since it contains new and deep insights on the classical problem of the quadrature of the circle, and particularly an argument for the impossibility of squaring the central conic sections analytically. Moreover, this manuscript represents a fortunate discovery, since it is the only known hand-written copy of the *Vera Quadratura*.

This tract comes from the manuscripts belonged to Vincenzo Viviani, the last disciple of Galilei. However, several questions about its history remain open: when was it written? Was it copied after the publication, or a draft of the book? Was it composed by Viviani himself? Hopefully, Viviani's collection gives us few more information. For instance, in another piece (Cr. 35 of Gal. 213) we learn from Viviani that the manuscript of the *Vera Quadratura*, was sent to him by the "principe Leopoldo de' Medici". This annotation is particularly important, because it gives us a *terminus ante quem* for the datation of the manuscript: it was certainly composed before December 1667, when Leopoldo de Medici became "Cardinale", and he was addressed with this title from then onwards. Moreover, a comparison with Gregory's handwriting shows that the manuscript was probably a scribal copy.

These details leave room for conjectures. Firstly, I shall venture the hypothesis that the manuscript cc 36r-46r reproduces the original version of the *Vera Quadratura*, that was later published with supplementary part in the form that we can still read today.

Secondly, this manuscript might have been submitted by Gregory himself, possibly through the intermediary of his mentors in Padua, to Leopoldo de Medici in order to look for Leopoldo's opinion or, more likely, for his patronage. Subsequently, Leopoldo passed it on to Viviani and possibly to other mathematicians. Finally, I shall conjecture, on the ground of a series of indirect evidence, that Gregory's book raised several objections among these first readers, which caused Leopoldo to refuse patronizing him. Despite the scarcity of direct sources, the study of Gregory's manuscript opens up new directions for investigation in the circulation of mathematical knowledge in XVIIth century Italy.

### **Alex Craik**

*George Sinclair on hydrostatics: negative reactions and bad luck*

George Sinclair, Glasgow University Regent, sought recognition from Robert Boyle and the Royal Society in London, and from St Andrews' James Gregory. Instead, he suffered violent criticism. Yet his work on hydrostatics was basically sound and his understanding comparable to that of Boyle. Aspects of these disputes are examined, and some recent biographical information presented.

### **Samuel Gessner**

*Thinking with instruments and the appropriation of logarithms on the Iberian Peninsula around 1630*

Lord Napier's tables and their explanation were actively publicised by the mathematical practitioners gravitating around Gresham college in London in the 1610s. In the spirit of that context characterised by an acute interest for mathematical instruments, Gunter and Oughtred, a few years later, devised logarithmic scales to put on instruments. Both sought the expertise of the instrument maker Elias Allen to turn their ideas into brass objects. This paper focuses on a Jesuit who lectured mathematics at the College of Santo Antão in Lisbon: Ignace Stafford. He elaborated two manuscripts in Castilian that touch upon logarithms in the 1630s. One is about trigonometry, the second is a practical arithmetic that systematically treats the various problems by Gunter's and Oughtred's logarithmic instruments. Stafford's books represent evidence of the impressive velocity with which the knowledge about logarithms and connected instruments spread to the other end of Europe and the readiness with which it has been absorbed into local treatise production. These exceptional sources prompt the question of the importance of instruments for new mathematical concepts to travel. In particular, they allow analysing the procedures by which the use of instruments shaped local appropriation of logarithms as they spread to the Iberian Peninsula.

**Albrecht Heeffer**

*The difficult relation of surveyors and algebra: the hundred geometrical questions of Cardinael*

When Clavius in 1608 dedicated a book on algebra, the practice of algebraic problem solving spread to wider circles than it was during the sixteenth century. With Descartes's *Geometry* of 1637, it was triumphantly shown that algebra could tackle the hardest problems on conic sections and curve geometry. However, not all early-modern geometers embraced the new algebra. One specific mathematical culture that deliberately avoided the use of algebra was the surveyor's tradition. Our case study on the Dutch book, *Hundred Geometrical Questions* by Cardinael published in 1612, addresses the questions why and how surveyor's problems were solved without the use of algebra.

**David Horowitz**

*John Craig (1663-1731)*

As a contemporary and acquaintance of Newton, Scottish mathematician John Craig wrote early treatises on fluents and quadratures. However he is most remembered for his controversial mathematical dating of the Second Coming of Christ. His much maligned *Theologiae Christianae Principia Mathematica* (Mathematical Principles of Christian Theology) published in 1699 attracted the outrage of theologians, historians and mathematicians for almost three centuries. However a recent examination suggests that Craig's work is an early precursor of modern theories on the transmission and survivability of historical testimony. More importantly Craig's writing offers a unique insight into the nature of apocalyptic thought and probability theory in the early eighteenth century.

**Alison Morrison-Low**

*Surviving scientific instruments from early modern Scotland: a survey*

When did instrument-making come to Scotland? In contrast to the rest of Europe, this activity appeared relatively late. Humphrey Cole was the first native-born English instrument maker, taught by immigrant Flemings in the last days of the Tudor dynasty. Items made locally before the Restoration of the Stuarts in 1660 remain extremely unusual. The earliest signed instrument made in Scotland is now held by National Museums Scotland, having appeared in a London saleroom in 1972. It is signed by Robert Davenport, who had served his apprenticeship with the great London maker Elias Allen, who was commissioned by William Oughtred to make both Oughtred's 'Circles of Proportion' (the earliest logarithmic calculating scale, which is on the reverse of this instrument) and the horizontal instrument, which used his form of stereographic projection. Davenport was working in Edinburgh by 1647, but it is not known for how long he stayed. This is the only instrument known with his signature, and was made for the latitude of Edinburgh. Of course, that is not to say that mathematical instruments or instruments used in

natural philosophy were unknown in Scotland before this date: and this paper will discuss a number of these.

### **Steve Russ**

*John Napier: the mysterious making of a mathematician*

Still well known today as an inventor of logarithms, John Napier (1550-1617) was much better known, and more widely known, in his own day as a leading, energetic promoter of the Scottish Reformation. But neither then, nor to any great extent now, did Napier enjoy the recognition he deserved as an able mathematician - not simply as a remarkably patient and persevering human calculator. It will be argued that this claim is justified solely on the evidence of his published works (including the posthumous publication in 1839 of his unfinished *De Arte Logistica*). In conclusion some comparison with his contemporaries and the current conjectures on the 'mystery years' (ca.1565 - 1571) will be sketched.

### **Jane Wess**

*Colin MacLaurin on Wind and Water: the Local and the Universal*

The paper looks at the letters and published works of Colin MacLaurin which concern issues relating to wind and water. It contrasts the debates had with local Scottish landowners regarding specific sites and problems, with the concept of a universally applied mathematics, about which Colin Maclaurin corresponded with the wider mathematics community before publishing.