Colin Maclaurin

Born: Feb 1698 in Kilmodan (12 km N of Tighnabruaich), Cowal, Argyllshire, Scotland
Died: 14 June 1746 in Edinburgh, Scotland

Colin Maclaurin was born in Kilmodan where his father, John Maclaurin, was the minister of the parish. The village (population 387 in 1904) is on the river Ruel and the church is at Glendaruel.

John Maclaurin was more of a scholar than one would expect of a parish minister, for he had translated the Psalms into Gaelic. Colin, however, never knew his father, for he died when Colin was six weeks old. Colin was the youngest of three sons, the oldest being John, while the second was Daniel who died at a young age. Colin Maclaurin's mother inherited a small estate in Argyllshire and it was on the estate that Colin spent the early years of his life. His mother wanted a good education for Colin and his brother John, so the family moved to Dumbarton where the boys attended school.

In 1707, when Colin was nine years old, his mother died so the task of bringing up Colin and his brother John fell to their uncle Daniel Maclaurin who was the minister at Kilfinnan on Loch Fyne. Colin became a student at the University of Glasgow in 1709 at the age of eleven years. This may seem an unbelievable age for someone to begin their university education, but it was not so amazing at this time as it would be today. Basically Scottish schools and universities competed for the best pupils at that time, rather than a university education being seen as following a school education as is the norm today.

Certainly Maclaurin's abilities soon began to show at Glasgow University. His first encounter with advanced mathematics came one year after he entered university, when he found a copy of Euclid's *Elements* in one of his friend's rooms. This was the standard text for mathematical study at this time, but Maclaurin studied it on his own, quickly mastering the first six of the thirteen books of the *Elements.* At Glasgow Maclaurin came into contact with Robert Simson who was the Professor of Mathematics there. Simson was particularly interested in the geometry of ancient Greece and his enthusiasm for the topic was to influence the young student Maclaurin. Tweddle in [23] looks at the correspondence between Simson and Maclaurin on conic sections 25 years after Maclaurin's student days at Glasgow.

At the age of 14 Maclaurin was awarded the degree of M.A. Although a master's degree in name, this was a first degree equivalent to a B.A. but the ancient Scottish universities (including St Andrews, my [EFR] own university) still retain the degree of M.A. as the first degree in Arts. However, Maclaurin had to defend a thesis in a public examination for the award of this degree (which is not the case today), and he chose *On the power of gravity* as his topic. The thesis, which developed Newton's theories, was written by a 14 year old boy at a time when such advanced ideas would only be familiar to a small number of the leading mathematicians.

After graduating with the degree of M.A., Maclaurin remained at the University of Glasgow for a further year to study divinity. It had been his intention to enter the Presbyterian Church but [7]:-

... becoming disgusted at the dissensions that had at that time crept into the church ...

he decided against that career.

After leaving Glasgow in 1714, Maclaurin returned to live with his uncle in the manse at Kilfinnan. These were happy years for Maclaurin who studied hard and walked in the nearby hills and mountains for recreation. He clearly attained a very high standard in mathematics for, in August 1717, he was appointed professor of

mathematics at Marischal College in the University of Aberdeen. The appointment followed ten days of examinations to find the best candidate and it is clear that, despite there being another outstanding candidate, Maclaurin had the most knowledge of advanced topics.

Maclaurin was to make two journeys to London, and the first of these he made in 1719. Maclaurin had already shown himself a very strong advocate of the mathematical and physical ideas of Newton, so it was natural that they should meet during Maclaurin's visit to London. It is surprising that some of Newton's biographers, for example A Rupert Hall in his 1992 biography, should declare that Maclaurin and Newton never met. Maclaurin writing of this visit to London in one of his letters (see for example letter 117 in [3]) states:-

I received the greatest civility from [*members of the Royal Society*] *and particularly from the great Sir Isaac Newton with whom I was very often.*

Maclaurin received more than civility from the Royal Society, for he was elected a Fellow of the Royal Society during this visit to London.

A rather strange event in Maclaurin's career took place during the time he held the chair of mathematics at Aberdeen. Lord Polwarth was a diplomatic agent of King George II. At this time it was customary for the sons of the top people to make a grand tour of Europe as part of finishing their education. Polwarth invited Maclaurin to accompany his son on such a grand tour and, it is not too surprising that Maclaurin accepted this chance to travel and meet with French mathematicians. What is surprising is that he does not appear to have sought the necessary permission of the university authorities in Aberdeen, although he does appear to have found someone to do his teaching. Turnbull writes however in [5]:-

... one wonders what was happening to his unshepherded classes in Marischal College. Had he forgotten all about them; did he turn a deaf ear to all calls to return; was there something in him, akin to the impenetrable aloofness of Newton, which shut him off from his fellows and his duties at times of mental creativity.

It was not a short tour, for Maclaurin spent two years travelling with Polwarth's son. It was an episode which was to end tragically, for while they were visiting Montpellier, Polwarth's son became ill and died. Maclaurin returned to Aberdeen to discover that the University was most certainly highly displeased that he had not been undertaking his duties for two years. It was certainly not the case that Maclaurin had been idle during his time away, for, while in France, he had been awarded a Grand Prize by the Académie des Sciences for his work on the impact of bodies.

Despite being reinstated to his chair by the University of Aberdeen, Maclaurin sought a position in the University of Edinburgh. James Gregory, not the famous mathematician of that name but rather the lesser known James Gregory who was a brother of David Gregory, held the chair of mathematics at Edinburgh but had become too ill to carry out the work. The University of Edinburgh sought to appoint someone to a joint professorship with James Gregory and, on 21 August 1725, Newton wrote to Maclaurin offering his support in recommending him for appointment to the post (see [1], or [7] or letter 122 of [3]):-

I am very glad to hear that you have the prospect of being joined with Mr James Gregory in the Professorship of Mathematics at Edinburgh, not only because you are my friend, but principally because of your abilities, you being acquainted as well with the improvements of Mathematics as with the former state of those sciences. I heartily wish you good success, and shall be very glad to hear of your being elected.

In November 1725 Newton wrote to John Campbell, the lord provost of Edinburgh, supporting Maclaurin's appointment (see [1], or [7]):-

I am glad to understand that Mr Maclaurin is in good repute amongst you, for I think he deserves it very well: And to satisfy you that I do not flatter him, and also to encourage him to accept the place of assisting Mr

Gregory, in order to succeed him, I am ready (*if you will please give me leave*) *to contribute twenty pounds per annum towards a provision for him till Mr Gregory's place becomes void, if I live so long.*

There is no evidence to suggest that Edinburgh took Newton up on his offer to contribute to Maclaurin's salary. Maclaurin began his appointment to the University of Edinburgh on 3 November 1725.

Maclaurin was to spend the rest of his career in Edinburgh. In 1733 he married Anne Stewart, who was the daughter of the Solicitor General for Scotland. They were to have seven children but, as was common at that time, not all reached adulthood. Of the seven children, two boys and three girls survived him. Not long after his marriage, Maclaurin worked to expand the Medical Society of Edinburgh into a wider society to include other branches of learning. Maclaurin himself acted as one of the two secretaries of this expanded Society and at the monthly meetings he often read a paper of his own or a letter from a foreign scientist on the latest developments in some topic of current interest. This Society would, after Maclaurin's death, become the Royal Society of Edinburgh.

Maclaurin did notable work in geometry, particularly studying higher plane curves. In fact his first important work was *Geometrica Organica...* published in 1720 while he was at the University of Aberdeen. In 1740 he was awarded a second prize from the Académie des Sciences in Paris, this time for a study of the tides. This prize was jointly awarded to Maclaurin, Euler and Daniel Bernoulli, bracketing Maclaurin with the top two mathematicians of his day.

In 1742 Maclaurin published his 2 volume *Treatise of fluxions*, the first systematic exposition of Newton's methods written as a reply to Berkeley's attack on the calculus for its lack of rigorous foundations. Maclaurin wrote in the introduction (see for example [1]):-

[*Berkeley*] *represented the method of fluxions as founded on false reasoning, and full of mysteries. His objections seemed to have been occasioned by the concise manner in which the elements of this method have been usually described, and their having been so much misunderstood by a person of his abilities appeared to me to be sufficient proof that a fuller account of the grounds of this was required.*

The *Treatise of fluxions* is a major work of 763 pages, much praised by those who read it but usually described as having little influence. The article [10], however, argues convincingly that Maclaurin's influence on the Continentals has been underrated. Grabiner gives five areas of influence of Maclaurin's treatise: his treatment of the fundamental theorem of the calculus; his work on maxima and minima; the attraction of ellipsoids; elliptic integrals; and the Euler-Maclaurin summation formula.

Maclaurin appealed to the geometrical methods of the ancient Greeks and to Archimedes' method of exhaustion in attempting to put Newton's calculus on a rigorous footing. It is in the *Treatise of fluxions* that Maclaurin uses the special case of Taylor's series now named after him and for which he is undoubtedly best remembered today. The Maclaurin series was not an idea discovered independently of the more general result of Taylor for Maclaurin acknowledges Taylor's contribution. Another important result given by Maclaurin, which has not been named after him or any other mathematician, is the important integral test for the convergence of an infinite series. The *Treatise of fluxions* is not simply a work designed to put the calculus on a rigorous basis, for Maclaurin gave many applications of calculus in the work. For example he investigates the mutual attraction of two ellipsoids of revolution as an application of the methods he gives.

Other topics which Maclaurin wrote on were the annular eclipse of the sun in 1737 and the structure of bees' honeycombs. He also contributed to actuarial studies as one of the founders of the topic and [5]:-

He laid sound actuarial foundations for the insurance society that has ever since helped the widows and children of Scottish ministers and professors.

Maclaurin did become involved in controversy with other mathematicians over a number of results. Two are well documented, one being with William Braikenridge (see our biography of Braikenridge in this archive, and also [16]) on the argument over the result:-

... if the sides of a polygon pass through fixed points and all but one of the vertices lie on fixed lines, then the remaining vertices describe a conic section or a straight line.

In [17] the controversy between Maclaurin and George Campbell over complex roots is described. Again the argument, which Maclaurin calls "a disagreeable dispute", was about priority.

We should not only comment on Maclaurin's mathematical research, however, but also on his qualities as a teacher. His teaching at the University of Edinburgh came in for considerable praise [7]:-

... such was his anxiety for the improvement of his scholars that if at any time they seemed not fully to comprehend his meaning, or if, upon examining them, he found they could not readily demonstrate the propositions from which he had provided, he was apt rather to suspect his own explanation to have been obscure, than their want of genius or attention, and therefore would resume the demonstration in some other method, to try if, by exposing it in a different light, he would give then a better view of it.

Maclaurin played an active role in the defence of Edinburgh during the Jacobite rebellion of 1745. As the Jacobite army marched towards Edinburgh in September 1745, Maclaurin worked endlessly in attempting to prepare the defences of the city. He described the events (see for example letter 100 of [3]):-

The care of the walls was recommended to me, in which I laboured night and day under infinite discouragements from superior powers. When I was promised hundreds of workers I could hardly get dozens. This was daily complained of, redress was promised but till the last two days no redress was made, and then it was too late.

When the city fell to the attacking Jacobites, Maclaurin fled to England and while in Newcastle he received an invitation from the Archbishop of York to be his guest in York. There he:-

... lived for some time as happy as was possible for a man who had left his country in such a situation and his family in it behind him.

When the Jacobite army marched south from Edinburgh, Maclaurin returned to the city in November 1745. However, he was weakened by his exertions in preparing the defences of Edinburgh, by the difficult journeys to and from York, by the cold winter weather, and by a fall from his horse. On 26 December 1745 he wrote:-

I have not been [*out*] *since December* 3. *My illness seemed dangerous, the physicians call it an obstruction in the reins from the severe cold in travelling November* 14, 15 *and* 16. *I had a swelling about my stomach.*

He died the following year in Edinburgh and was buried in Greyfriars Church where his grave can still be seen at the south-west corner.

Many wrote of Maclaurin's outstanding kindness. He was described as [7]:-

... kindly and approachable ...

and it was said that the help he gave to his students:-

... was never wanting; nor was admittance refused to any except in his teaching hours.

His friendship was exceedingly highly valued:-

His acquaintance and friendship were ... centred by the ingenious of all ranks; who by their fondness for his company, took up a great deal of his time, and left him not master of it, even in his country retreat.

Maclaurin's *Treatise on algebra* was published in 1748, two years after his death. Another work *Account of Sir Isaac Newton's discoveries* was left incomplete on his death but was published in 1750. One of his papers remained unpublished until 1996 when Grabiner published [11]. In this work Maclaurin considers the geometric problem of finding the difference between the volume of the frustum of a solid of revolution which is generated by a conic section and the volume of the cylinder of the same height as the frustum having diameter equal to that of the frustum at the midpoint of its height.

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