Colin Maclaurin

Many consider **Colin Maclaurin (**February, 1698 – June 14, 1746) the best British mathematician of the generation after Newton. Maclaurin published the first logical and systematic exposition of the method of fluxions and the correct theory for distinguishing between maximum and minimum values of a function. In solving problems, whether they dealt with mathematics, gravitational theory of the earth, taxation, actuarial theories, map making or theology, he employed a combination of sophisticated mathematical modeling and empirical data. Unfortunately, much of his tremendous output has been forgotten, partly because his methods grew unfashionable, while others have been superseded by better approaches. The series [Figure 6.4], a special kind of Taylor series, states the conditions under which such a series exists for a function *f*. Its remainder term can be written in the same forms as that of a Taylor series. The series is named in Maclaurin's honor although it was well known before he published it.

Maclaurin Series

$$f(x) = f(0) + xf'(0) + \frac{x^2}{2!}f''(0) + \frac{x^3}{3!}f'''(0) + \dots$$

Figure 6.4

Maclaurin was descended from an ancient family that had long owned the island of Tiree, a solitary but beautiful part of the Hebridean range. His grandfather moved the family to Inverary and contributed to the restoration of that town, which nearly had been destroyed in civil wars. Colin was born in Kilmodan, Scotland, where his father was the minister of the parish. Maclaurin never knew his father, who died when the child was only six weeks old. His mother inherited a small estate in Argyllshire

where the family lived until moving to Dumbarton where the boy attended school. When he was nine his mother died and his upbringing fell to his uncle Daniel Maclaurin, a minister at Kilfinnan. Although of a delicate constitution, Colin was remarkable for the quickness of his understanding and his outstanding memory.

Maclaurin entered the University of Glasgow at age eleven, which was not as remarkable then as it would be today. His teachers were astonished by the ease and quickness with which he surpassed all the other students. He delighted in the writings of the ancients. From the time he entered the university he kept a diary in which he recorded the beginning and success of every study, inquiry or investigation, his conversations with learned men, the subjects of these talks, and the arguments given by both sides. His genius for mathematics became clear at age 12 when he accidentally discovered a copy of Euclid's *Elements,* which he soon mastered without help. At the age of 14 he was awarded the degree of M.A. The degree was a master's degree in name, but equivalent to a B.A. For ancient Scottish universities, the M.A. is still the first degree in the Arts. To earn his degree Maclaurin defended a thesis *On the power of gravity*, a development of Newton's theories. Now this was remarkable; a 14 year old boy was expounding on advanced ideas known by only a few leading mathematicians of the time.

Maclaurin returned to his uncle's home where he studied advanced mathematics and its applications, particularly the works of Newton. At age 19, he was elected professor of mathematics at Marischal College at the University of Aberdeen. Eight years later he was in competition for the position as the deputy of James Gregory, the mathematics professor at Edinburgh, whose age and infirmities rendered him incapable of teaching. In a letter of recommendation he sent to the provost supporting the appointment of Maclaurin to the post, Newton wrote:

"I am glad to understand that Mr. Maclaurin is in good repute amongst you for his skill in

mathematics, 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 … to contribute twenty pounds per annum towards a provision for him till Mr. Gregory's place becomes void, if I live so long, and I will pay it to his order in London."

Newton's generous offer was declined. The Edinburgh town council decided that Gregory would retain his salary during his life and Maclaurin was to be paid fifty pounds per annum, in addition to the fees he collected from his students, on the condition that he perform all of the duties of the office. In 1733 he married Anne Stewart, daughter of the Solicitor General of Scotland. In 1745 Maclaurin took an active role in opposing the advance of the Young Pretender to the Scottish throne and enthusiastically assisted in preparing trenches and barricades for defending Edinburgh from the Jacobite army. He was placed in charge of strengthening the walls, but when the city fell to the Highlanders Maclaurin fled to York. The exposure in the trenches at Edinburgh and the privations he endured at the time so sapped his strength that the brave Scotsman took ill and died of dropsy the following year.

Maclaurin is best known for his works, *Geometrica Organica* (1720), *Treatise of Fluxions* (1742), and his posthumously published *Treatise on Algebra* (1748). In the *Geometria* Maclaurin dealt with conics, cubics, quartics, and general properties of curves, such as the so-called *trisectrix of Maclaurin*, [Figure 6.5] which he investigated while studying the ancient problem of the trisection of an angle. Its equation in Cartesian coordinates is given by $y^2 = x^2(3 + x) / (1 - x)$

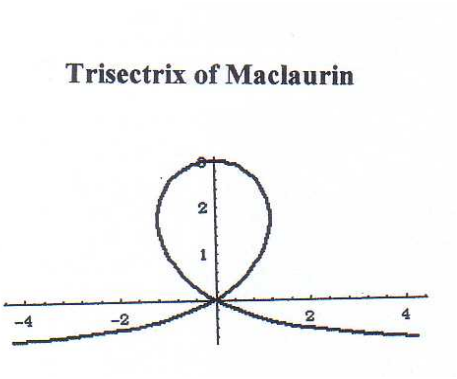

Figure 6.5

Maclaurin's *Algebra* was based on Newton's *Universal Arithmetic*. It contained results on the number of imaginary roots of an equation and was unusual for its time in its treatment of negative quantities as being no less real than positive quantities. Many students view so-called word problems with dread, but if they believe them to be a modern affliction they are mistaken. Such problems existed long before Colin Maclaurin assigned the following. "A man and his wife usually drink a keg of beer in 12 days. They found by often experience that when his wife was absent the man drank it in 20 days. In how many days will the wife alone drink it?"

Maclaurin's *The Treatise of Fluxions* examined Newton's calculus. It was meant to be an answer to an attack by Bishop George Berkeley on the principles of the infinitesimal calculus. Maclaurin attempted to put Newton's work on a rigorous footing, and although the book was much admired, it was not widely read. It wouldn't be until the 1820s, when the French mathematician Augustin Cauchy overcame the problems with Newton's notion of vanishing quantities by introducing the concept of a limit. Maclaurin, the strongest advocate of Newton's mathematical and physical ideas, induced English mathematicians to confine themselves to the master's geometric methods, rather than the analytical point of view used in mainland Europe by Leibniz and his disciples. It was not until 1820, when the

differential calculus was introduced into the Cambridge curriculum, that English mathematicians finally adopted the more powerful methods of modern analysis. In "The Newton-Leibniz Controversy Concerning the Discovery of the Calculus," *The Mathematics Teacher*, May 1962, Mathematical historian Dorothy Schrader wrote:

> "The results of the Newton-Leibniz controversy in terms of the personal pain and mental disturbances suffered by the two principal protagonists cannot… be adequately judged. The effect of the controversy on the mathematical world seems to be twofold. As far as credit for the discoveries is concerned, today the two men are honored equally as two independent inventors. Concerning the development of analysis, England seems to have been the loser. The world of mathematics progressed. German and French mathematicians established reputations for themselves and their countries, while England remained insular and isolated."

Quotation of the Day: "The supposition of an infinitely little magnitude [is] too bold a Postulate for such a Science as Geometry." - Colin Maclaurin