

August 24, 2000

The Transition to Calculus - Part III ¹

1 Isaac Barrow

Isaac Barrow was born in Oct 1630 in London, England and died on May 4, 1677, also in London. He was the first Lucasian Professor of Mathematics (1663) at Cambridge. He probably learned much of his mathematics during the 3 years he travelled abroad in Europe (Paris, Florence, Smyrna, Constantinople, and Venice, Germany, Netherlands).



His interests were very broad, including Greek, religion and mathematics.

As a professor, he was required to give lectures and in 1664-65 he gave a series of lectures which Newton almost certainly attended. The 64-65 lectures dealt with the general concepts of space, time and motion. Barrow had by this time already begun to consider the study of curves as the paths of moving points.

His book *Lectiones geometricae* dates from this period, at least the first five lectures anyway. Some of the interesting points are the philosophical foundations for his ideas of Time and Motion and the geometric representation of such magnitude à la Oresme and Galileo. He combines both the indivisibility and infinitesimal ideas. Barrow covers much the same material as Gregory but does so more deeply in both foundations and development.

He relinquished the Lucasian chair to Issac Newton in 1669 and was appointed Doctor of Divinity by Royal mandate in 1670 and Master of Trinity College in 1672.

Barrow's lectures for the years 1664 to 1666 were only published in 1683 after his death. His *Lectiones Opticae* and *Lectiones Geometricae*

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Since

$$\text{space } PDEG < \text{rectangle } PD \cdot DE$$

and

$$PG < DE$$

it follows that

$$R \cdot FL < PD \cdot DE$$

$$R/DE < PD/FL.$$

Thus, if a line FT be drawn through F , meeting the axis AD at T and such that

$$TD/DF = R/DE,$$

and if IL meets FT in K , then

$$KL/FL = TD/DF = R/DE$$

and therefore

$$KL/FL < PD/FL$$

$$KL < PD = IL.$$

Hence K lies below the curve. To complete the proof, it is necessary to reason for points G, I' on the other side of E, F , where in the slope inequality is reversed. This proves that TF is tangent to AIF at D and has slope equal to DE . Some attention needs also be given to confirming that the area graph does not have a “corner” at F . In modern terms, what Barrow has proved is that

$$\frac{d}{dx} \int_a^x f(t) dt = f(x).$$

3 Summary

Barrow's *Geometrical Lectures* should be viewed as the culmination of all the 17th century geometrical investigations leading to the calculus. It is the most systematic – detailed treatment of tangents arcs, areas, etc. In the hands of Newton and Leibnitz, this led to the invention of the calculus. Barrow integrated the concepts of time and motion with those of space suggested by Torricelli, Galileo and Roberval. Barrow was a skillful geometer. His thinking was geometrical. He gave little attention to analytical procedure or problem solving. He was somewhat disappointed by the lack of impact of his work.

DID BARROW INVENT THE CALCULUS?

4 References:

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