How the calculus was invented?

Science, Mathematics

Calculus, historically known as infinitesimal calculus, is a mathematical discipline focused on limits, functions, derivatives, integrals, and infinite series. Ideas leading up to the notions of function, derivative, and integral were developed throughout the 17th century, but the decisive step was made by Isaac Newton and Gottfried Leibniz. Publication of Newton's main treatises took many years, whereas Leibniz published first (Nova methodus, 1684) and the whole subject was subsequently marred by a priority dispute between the two inventors of calculus.

Greek mathematicians are credited with a significant use of infinitesimals. Democritus is the first person recorded to consider seriously the division of objects into an infinite number of cross-sections, but his inability to rationalize discrete cross-sections with a cone's smooth slope prevented him from accepting the idea. At approximately the same time, Elea discredited infinitesimals further by his articulation of the paradoxes which they create.

Antiphon and later Eudoxus are generally credited with implementing the method of exhaustion, which made it possible to compute the area and volume of regions and solids by breaking them up into an infinite number of recognizable shapes. Archimedes of Syracuse developed this method further, while also inventing heuristic methods which resemble modern day concepts somewhat. (See Archimedes' Quadrature of the Parabola, The Method, Archimedes on Spheres & Cylinders.) It should not be thought that infinitesimals were put on a rigorous footing during this time, however.

Only when it was supplemented by a proper geometric proof would Greek mathematicians accept a proposition as true. It was not until the time of Newton that these methods were incorporated into a general framework of

integral calculus. Archimedes was the first to find the tangent to a curve, other than a circle, in a method akin to differential calculus. While studying the spiral, he separated a point's motion into two components, one radial motion component and one circular motion component, and then continued to add the two component motions together, thereby finding the tangent to the curve.

The pioneers of the calculus such as Isaac Barrow and Johann Bernoulli were diligent students of Archimedes; see for instance C. S. Roero (1983). Before Newton and Leibniz, the word “ calculus” was a general term used to refer to anybody ofmathematics, but in the following years, " calculus" became a popular term for a field of mathematics based upon their insights. The purpose of this section is to examine Newton and Leibniz’s investigations into the developing field of infinitesimal calculus.

Specific importance will be put on the justification and descriptive terms which they used in an attempt to understand calculus as they themselves conceived it. By the middle of the seventeenth century, European mathematics had changed its primary repository of knowledge. In comparison to the last century which maintained Hellenistic mathematics as the starting point for research, Newton, Leibniz and their contemporaries increasingly looked towards the works of more modern thinkers.

Europe had become home to a burgeoning mathematical community and with the advent of enhanced institutional and organizational bases a new level of organization andacademicintegration was being achieved. Importantly, however, the community lacked formalism; instead it consisted of a disordered mass of various methods, techniques, notations, theories,

and paradoxes. Newton came to calculus as part of his investigations in physics and geometry. He viewed calculus as the scientific description of the generation of motion and magnitudes.

In comparison, Leibniz focused on the tangent problem and came to believe that calculus was a metaphysical explanation of change. Importantly, the core of their insight was the formalization of the inverse properties between the integral and the differential. This insight had been anticipated by their predecessors, but they were the first to conceive calculus as a system in which new rhetoric and descriptive terms were created. Their unique discoveries lay not only in their imagination, but also in their ability to synthesize the insights around them into a universal algorithmic process, thereby forming a new mathematical system.