Leonhard Euler

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Leonhard Euler's life

Leonhard Euler was born April 15th 1707. His father was a Pastor and his mother a Pastor's daughter. They were devoutly religious people, and Euler followed in their steps, never questioning. He was the oldest of three, and the only son. While he was born in the town of Basel, Switzerland, his family moved shortly afterwards. The town of Riehen is where he grew up along with his two sisters Anna Maria and Maria Magdalena.

Euler began his formal education in Basel, where he lived with his mother's mom. He was only thirteen years old when he started at the University of Basel, and in three years he achieved a Masters in Philosophy. His dissertation was one that compared the thoughts of Descartes and Newton.

Even through all that he had been receiving Sunday lessons from Johann Bernoulli due to the fact that Euler's father was very good friends with the Bernoulli family. Johann Bernoulli was regarded as the foremost mathematician in Europe, at least back in the 1700's. He is also regarded as one of the biggest influences on Euler in his earlier days. Bernoulli found out that Euler had an incredible gift. He was highly talented in mathematics, especially for a teenager. While Euler did get a Masters in philosophy, this was mainly due to his father's urging. His other studies included theology, Greek and Hebrew. These were all classes of a Pastor, not a mathematician. Bernoulli convinced Euler's father to stray from this path, saying that Euler was destined to become a great mathematician.

Euler completed his dissertation studying the speed of sound in 1726 titled De Sono.This was the piece that convinced him that the path of mathematics was the right one for him. To exercise his mind he would frequent competitions like the Paris Academy Prize Problem Competition. This was a yearly event put forth by the French to try to advance the science innovations. However, he did not win the Paris Academy Prize Problem Competition. It should be noted however, that the subject was the best way to position masts on a boat, and he lost to Pierre Bouguer, a man that would become the father of naval architecture. Also, he did go on to win for the next twelve years.

While his attempt to work at University of Basel was unsuccessful, other plans were underway for him. Bernoulli's two sons, Daniel and Nicolas headed the departments of physiology and mathematics/physics respectively at the Imperial Russian Academy of Sciences in St Petersburg. When Nicolas died of appendicitis, Daniel took his spot and recommended Euler for the position he just vacated. Euler accepted the offer in 1726, just after he was unsuccessful at becoming a physics professor at University of Basel.

The academy in Saint Petersburg was established by Peter the Great, and was headed by Catherine I, until she died. They both had very progressive outlooks, and wanted to use the library to advance eastern knowledge to that of the Western Europe. Therefore, professors had plenty of time for personal research and self-thought. Due to that, the incredible amount of financial resources available, and the vast array of books, the academy was an easy attraction for Euler.

In May of the next year he arrived at Saint Petersburg. He was quickly promoted from his post to one in the mathematics department, as his talent for mathematics was easily shown. It was also at this time that he took on a post as a medic in the Russian Navy. Unfortunately, Catherine I died on the day of Euler's arrival. With a twelve year old boy on the throne, nobility seized the true power. Funding was cut until Peter II died, and Euler rose to professor of Physics in seventeen hundred thirty one. When Daniel left back for Basel due to the censorship he faced in Saint Petersburg, Euler became the head of the mathematics department.

Only a few years later in 1734 he married Katharina Gsell, the daughter of a painter. They lived in a small home by the Neva River close to Saint Petersburg. While they had thirteen children, only five survived to childhood. One in particular, Johann Euler, the oldest and named after Johann Bernoulli, would also go on to become a great mathematician.

Due to both the political turmoil and censorship in Russia, Euler left when Frederick the Great, of Prussia offered him a position at the Berlin academy in 1741. He stayed for twenty five years, and wrote nearly 400 articles. It was here that he wrote his two most famous works: The Introduction in analysin infinitorum, a text on functions published in 1748, and the Institutiones calculi differentialis, published in 1755 on differential calculus. He was also chosen as a foreign member of the Royal Swedish Academy of Sciences. Along with this he tutored Frederick's niece, the princess of Anhalt-Dessau. The letter he wrote to her give an enormous insight on Euler. He was a deeply religious man, to the point where he never thought to change things in the world and believed in biblical inerrancy, the idea that the bible was without fault. Due to this, he eventually began to annoy Frederick, who believed him to be an unsophisticated man beyond mathematics. Despite this, he was able to clearly articulate scientific topics to the average man or women, a skill not possessed by most researchers.

Unfortunately, Euler had deteriorating eyesight. He became nearly blind in his right eye, possibly due to a fever that nearly killed him. In 1766, a cataract was found in his left eye. A few weeks after that, he was rendered nearly blind. However, his mind was still just as sharp. With the help of aides, it is said that his productivity nearly increased. In 1755, he produced on average, one mathematical paper every week.

The political situation in Russia stabilized after Catherine the Great's accession to the throne, so in 1766 Euler accepted an invitation to return to the St. Petersburg Academy. He wanted a massive salary, high positions for his sons and a pension for his wife, all of which he received. However, this time Russia did not do him well. He lost his home in a fire in 1771. Two years later his wife died, after 40 years of marriage. He then married her half-sister, Salome Abigail Gsell. In September 1771, Euler had surgery to remove his cataract. The surgery was very successful - the mathematicians vision was restored. Unfortunately, Euler didn't take care of his eyes; he continued to work and after a few days lost his vision again, this time without any hope of recovery.

He died September 18th, 1783 in Saint Petersburg, Russia from a brain hemorrhage. It is said that Euler was discussing the newly discovered planet Uranus and its orbit with Anders Johan Lexell, when he collapsed. He died a mere few hours later at the age of 76 and was buried next to Katharina. It was said that he lived a reputable life. At the time of his death Pierre-Simon Laplace said this about Euler's influence on mathematics: "Read Euler, read Euler, he is the master of us all." He lived a very simple life and was a highly religious man. He didn't care about the social order of the world nor about changing status quo. He solely wished to life his life through mathematics.

Leonhard Euler's mathematical works

Euler has had a massive role in the furthering of mathematics. He contributed to mathematical notation, analysis, graph and number theory. He also played a part in applied mathematics. While he is most known for these, he also helped further astronomy and physics. Euler believed that knowledge is founded in part on the basis of precise quantitative laws, such that it had to be able to be measured. Euler is still the only mathematician to have two numbers named after him: the important Euler's Number in calculus, e, which is approximately equal to 2.71828, and the EulerMascheroni constant γ (gamma) sometimes referred to as just "Euler's constant", which is approximately equal to 0.57721. In fact, the sheer amount of material he created was astounding. His unpublished works were being published by the academy in Saint Petersburg for nearly 50 years after his death.

Due to Euler writing many textbooks during his time at both the Russian and German academies, he caused a lot of new mathematical terms to come into use. He created the concept of a function, and brought the idea of writing f(x) to show that the function f applied to the argument x. The letter e for the base of a natural logarithm, was first used by him. This later went on to be called Euler's number. He popularized the use of the Greek letter Σ for summations and the letter i to denote the imaginary unit. And while he did not start the use of π to show the ratio of a circle's circumference to its diameter, he did cause it to gain much more common use by increasing its popularity. While these may not seem like major mathematical advances, Euler caused the consolidation of math terms. This common use of them made accessible and understandable. Without it, collaboration in mathematics would have been impossible without serious time spent explaining each other's notation to each other. Euler was a key factor in streamlining mathematics for the future mathematicians.

Calculus was originally called "the calculus of infinitesimals" or the study of things so small there is no way to measure them. Much of the progress done in the 18th century in infinitesimal calculus was done by the Bernoulli family. Due to Euler's close relationship with them, he was at the forefront of mathematical analysis, the study of functions, sequences and series to study continuous functions, differential calculus and integration. In particular, Euler focused on the power series and the expression of functions as sums of infinitely many terms.

$$f(x) = \sum_{n=0}^{\infty} a_n(x-c)^n = a_0 + a_1(x-c) + a_2(x-c)^2 + a_3(x-c)^3 + ...$$

In a Power Series an represents the coefficient of the nth term, c is a constant, and x varies around c

$$e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!} = \lim_{n\to\infty} \left(\frac{1}{0!} + \frac{x}{1!} + \frac{x^2}{2!} + ... + \frac{x^n}{n!} \right)$$

The expression of functions as sums of infinitely many terms used the basis of Euler's constant to solve. It is directly based on the foundation of Euler's Constant.

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \lim_{n\to\infty} \left(\frac{1}{1^2} + \frac{1}{2^2} + ... + \frac{1}{n^2} \right)$$

He used the Power series to directly prove the Basel problem which asks for the exact summation of the reciprocals of the squares of the natural numbers. While the approximate solution was known, Euler found the exact answer to be $\frac{\pi^2}{6}$. While his proof was published in 1735, it was not accepted until 1741. He also discovered the exponential function for complex numbers, and discovered its relation to the trigonometric functions. Euler's formula states that for any real number φ (in radians) complex exponential function satisfies

$$e^{i\varphi} = cos\varphi + sin\varphi$$

This is often called the most beautiful equation in mathematics. It allows to show a direct relationship between trigonometric functions and the complex exponential function. This advancement in mathematics opened the floodgates for applications in applications in complex number theory, trigonometry and topology. He also introduced the gamma function, which is the factorial function shifted down by one, which is however only true for real and positive numbers. Euler believed in quantitative methods to solve number theory problems, leading to the creation of an entirely new field of study, analytic number theory. He used analytic methods to give insight to developing the prime number theorem, the age old question of if prime number go on forever.

Euler also developed and disproved some of Pierre de Fermat's ideas and conjectures. Euler proved Newton's identities, Fermat's little theorem, Fermat's theorem on sums of two squares, and he made distinct contributions to Lagrange's four-square theorem. He generalized Fermat's little theorem, officially renaming it as Euler's Theorem. Ever since Euclid and the theory of perfect numbers, mathematicians were very fascinated by perfect numbers. Euler proved that the relationship between perfect numbers and Mersenne primes-a prime number that is one less than a power of two, was one-to-one. Using this, Euler had proved that 2^{31}-1 = 2,147,483,647 is a Mersenne prime.

In addition to that, Riemann zeta function, which is so important because of its relation to the distribution of prime numbers. The theorem states that the probability of finding a prime number between 1 and a given number becomes smaller, as numbers grow larger, due to multiples of numbers increasing. Euler's proof starts with

$$\sum_{n=1}^{\infty} \frac{1}{n^s} = \prod_{p} \frac{1}{1 - p^{-s}}$$

An interesting result can be found for $\zeta(1)$

$$...\left(1 - \frac{1}{11}\right)\left(1 - \frac{1}{7}\right)\left(1 - \frac{1}{5}\right)\left(1 - \frac{1}{3}\right)\left(1 - \frac{1}{2}\right)\zeta(1) = 1$$

Which can also be written as,

$$...\left(\frac{10}{11}\right)\left(\frac{6}{7}\right)\left(\frac{4}{5}\right)\left(\frac{2}{3}\right)\left(\frac{1}{2}\right)\zeta(1) = 1$$

which is,

$$\left(\frac{..10\times 6\times 4\times 2\times 1}{...11\times 7\times 5\times 5\times 3\times 2}\right)\zeta(1)=1$$

so when 1 is plugged in for ζ,

$$\zeta(1)=1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+...$$

This can be rewritten to show that

$$1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+...=\frac{2\times 3\times 5\times 7\times 11...}{1\times 2\times 4\times 6\times 10...}$$

When zeta is equal to one, Euler was able to prove that there was infinite amount of primes due to the fact that the left side of the equal sign diverges to infinity, therefore the right side must also diverge. This proves that there are limitless amount of primes numbers.

Euler also played a major role in the use of graph theory. In fact he is seen as creating the first ever proof of graph theory. The problem was of this city in Knigsberg, Prussia. The city has been called Kaliningrad since 1946. There was a river with seven bridges connected to both each other and the city itself. It was asked if there was a way to cross each bridge exactly once and still end up at the same place where you started from. Euler's proof, stated there was no way to do this. He first drew an abstract graph of the problem to make it easier to visualize, as the only important sequence is the actual bridges, not the shape of the picture itself. When one crosses a bridge, there must be an even amount of vertices leaving from it, with the only exceptions being the endpoints. For there to be a singular path, each land mass, besides the first and last ones must have an even amount of bridges touching it. However, in the problem, all the land masses have an odd amount of bridges. One is being touched by 5 bridges and the other three are being touched by 3 bridges. Therefore Euler negatively proved that crossing each bridge only once is impossible. There can be only either zero or two masses with an odd amount of bridges. This is now called an Eulerian path. If there are nodes of odd degree, then any Eulerian path will start at one of them and end at the other. And while this may seem unnecessary or highly hypothetical, it has led to incredible gains in the advancement of graph theory. We live in a world linked together, whether they be streets, rails, or paths. Everything in our world is linked: cities are linked by street, rail and flight networks. The different components of an electric circuit or computer chip are connected and the paths of disease outbreaks form a network. Scientists, engineers and many others want to analyze, understand and optimize these networks. And this can be done using graph theory.

Over the many years of his life, Euler influenced and created many parts of mathematics. He was praised by Pierre-Simon Laplace, who said: "Read Euler, read Euler, he is the master of us all. Euler changed the field of mathematics, and mathematics made several leaps and bounds due to him. Without him, today's mathematics, physics and even abstract mathematics would be very different. Leonhard Euler was the most published mathematician of all time. There is probably not a single branch of mathematics known during his lifetime which he did not influence.

Collaboration with other scholars

Daniel Bernoulli was the son of Johann Bernoulli, the man who is regarded as one of the early founders of calculus. He was also a close friend of Euler, due to his father teaching both of them math. While he was

highly capable in mathematics, his father asked him to study business and then medicine, believe that a mathematician was a poor man's profession. However, he only agreed if his father would continue lessons with him privately. It was due to this connection that he met Euler. They worked in close contact with each other at Saint Petersburg's Imperial Russian Academy of Sciences. It was here that they worked on the Euler-Bernoulli beam theory around the 1750's based on the significant discoveries of Jacob Bernoulli. He published a preliminary idea in the 1694, and another one in 1705, the year of his death.

The Euler-Bernoulli beam describes the relationship between the beam's deflection and the applied load of a beam. The defection is the degree of the bend in a beam due to the load placed on it. A beam can only hold so much, and in the age where buildings were going up overnight, it was crucial to know if the building would support itself. This equation caused the building of numerous bridges and buildings, but it was in the 19th century that is was truly used in its full potential when it was used to prove the validity that the Eiffel Tower and Ferris wheel would stand, especially on such a large scale.

This equation is able to provide reasonably easy and simple answers to common engineering problems. However, it does tend to slightly over exaggerate the natural frequencies of the beam. Also it is better at finding the relationship for slender beams. It also is only applied to lateral loads. Therefore, it is not always practical, but it was a cornerstone in the second industrial revolution. The equation

$$\frac{d^2}{dx^2}\left(EI\frac{d^2w}{dx^2}\right) = q$$

uses the curve w(x) to describe the deflections of the beam in the Z direction at an unknown position x. Due to the beam being modeled as a one dimensional object, and deflection would be in the Z direction. q is the evenly distributed load. This equation, while it may have some limitations, was one of the most widely used equations. It was able to show that the link between mathematics and engineering wasn't as abstract as before. Math did, in fact, have a practical application.

Historical events that marked Leonhard Euler's life.

While Euler was born and grew up in Rihen and Basel, he spent most of his adult life in either Saint Petersburg, Russia or Berlin, Germany. Of the years that Euler lived in Russia, Russia was at war for a majority of them with the Ottoman Empire. On the other hand, the 25 years Euler spent in Berlin are marked as a time of great enlightenment and philosophical progress.

Prior to 1721, Russia was ruled by Peter the Great and subsequently by Catherine I, both highly progressive monarchs. They wanted to advance Russia's scientific progress. Peter the Great created libraries and the Imperial Russian Academy of Sciences with the idea to attract foreign scientists to come and research there. That along with the generous financial resources made it an easy choice for people like Euler to go there. Unfortunately, Catherine I died the very day that Euler arrived in Saint Petersburg. The next monarch, a twelve year old boy Peter, was nothing more than a figurehead for the throne. The nobles that truly held the power were highly distrustful of the foreigners and consequently made life very hard for Euler at the academy. Peter II had very little interest in ruling Russia and rather choose to spend his days feasting, gambling and drinking. Russia, as a country, fell to ruin, as people began to steal for survival and crime rate was high. Peter moved the capital back from Saint Petersburg to Moscow, a bothersome move had little to no reason. He hated learning and thinking about national affairs. He was totally engrossed in amusements, and was kept under someone else's influence. He died in 1730, making Euler's life easier as his successor, Anna Ioannovna, cared much more about improving Russia in comparison to Europe.

In 1735 war broke out between Russia and the Ottoman Empire due to the continuing raids by the Crimean Tatars, a Turkic ethnic group in the Ottoman Empire that would regularly raid the coasts of Russia. This caused the loss of lives, homes and belongings to the Russian people. However at that time the Ottoman Empire was at its peak. It had yet to be defeated in a battle and was making strong land advancements. Russia was also fighting for it's access to the Black Sea, the closest port that didn't freeze over entirely in the winter. This would have greatly increased the export business for the Russians and help improve their economy. However, even with the help of Austria, the Ottoman Empire had the support of Sweden and therefore won. Russia signed the treaty of Nis with Turkey on September 29, which ended the war.

However, Russia went back to war with the Ottoman Empire from 1768 to 1772. Ironically, when Euler had left for Berlin, Russia was at peace with the Ottoman Empire. This conflict arose from Poland. The throne of Poland was in the pocket of Russia. The Ottoman Empire demanded that Russia stay out of Poland's governmental affairs, which lead to the opposite response. However this time Russia was under estimated. The monarch, Catherine II, won over the people. The army captured Azov, Crimea, and Bessarabia. Russia also upturned Moldavia, the first time Russian troops had crossed the Caucasus. In Bulgaria, the Ottoman Empire had startling defeats, unable to hold their own against the Russia's massive amount of foot soldiers. The Ottoman Empire signed the Treaty of Kucuk Kaynarca on July 21st, 1774. Russia got very little in land masses, but it got the true prize of Poland. Is also gave Russia the access to the Black Sea Ports that it fought for in the previous wars. It also opened the way for more eventual Russian advancement in the Balkans. This is also seen as the beginning of the death of the Ottoman Empire.

Euler also spent 25 years in Berlin working in close relationship with Frederick the Great. This was when the enlightenment came around in Prussia and the German states. It was a time when intellectual forces in Western Europe emphasized reason, analysis, and individualism rather than traditional lines of authority. The upper class thinkers would gather in coffee houses and talk and discuss philosophy and challenging the status quo. However, Euler was a simple man with simple thoughts. He had no urge to change, or debate with the courts, churches or the government. This led to Frederick becoming irritated with his mindset, and his eventual return to Russia.

At this time, Prussia and the German states, which would eventually form Germany, were at war on and off with Austria over the Silesia area. There were 3 wars in total, and they all ended in Prussian victory. The final war is often considered a world war because of the involvement of almost all the major countries in Europe. In terms for Russia and Prussia, it's called the Seven Years War. It had a personal effect on Euler. Troops came in and ransacked his home. While he and his family were entirely safe, he was paid enormous reparations for that, by the Russians. Euler was viewed so highly by them that they did this regardless of the fact that he was still working in Berlin at the time. The war ended with Prussia having complete control over Silesia, and obtaining a status quo ante bellum, where all parties involved agreed to return to a pre-war type of state.

Much of Euler's life was spent living in countries that were at war. This could not have had no influence on Euler. Even with a much larger salary than most people back then, he must have also felt the negative, and positive, consequences of living in a time of constant warfare.

Significant historical events around the world during Leonhard Euler's life

Great Britain was at the height of its worldwide colonization. It had made strong hold in India and parts of Africa. In India this is called the East India Company Rule. There were very few protests by the Indian people at this time period, rather they were done in small numbers and unorganized and therefore ineffective. In 1770 the British decided that they wanted to colonize Australia. They would later start sending their prisoners there for civil courts, it became known as the land of the criminals sent for rehabilitation. In the 1770's the industrial revolution started in England with the newer steam engine, and the production of mass factories

and conveyor belts. This would go on to cause production in many other countries and the destruction of the environment.

Japan was still an isolationist country at this time period, but people started to sneak in literature from the Dutch ships. Unrest grew of the government due to the poor handling of the famines, and the culture of social class started to break down. People began to marry out of their class, and took jobs that they were no longer born into. With the expansion of schools and public education, the literacy rate was at an all time high, at over 40 percent. This may be the highest in all the world at this time period.

The British ruled their colonies with an iron grip when it came to trade. The North American colonies weren't allowed to trade independently, they had to go through the British, who would always turn around and sell at a higher profit to the other countries. Also they weren't allowed to sell to people that England did not approve of, which greatly hindered the colonies economy. Along with unfair taxes, the colonies revolted in 1775. In July of 1776, the continental Congress signed the Declaration of Independence, stating that the colonies were all free to govern as they wish. In 1783, after a long war, and the help of the French, Britain was forced to sign a treaty that granted the colonies independence, making the United States of America a country.

In Africa, particularly in the Sahel region in the 1700's, the drought got so bad that people started selling themselves into slavery in order to provide for their families. In Timbuktu, it is said that it got so bad that nearly half the population died of starvation. With the lack of concern and resources from Europe, Africa was a country riddled with hunger.

In 1783, the volcano, Laki, in Iceland erupted. It went on for eight months spewing gas and lava. The lava is recorded to go as high as 4600 feet, and the gasses as high as 10 miles. This is known as one of the most climate-changing events of that century. It was also one of the most damaging in the terms of crops. There was a release of 120 million ton of sulfur dioxide, and 8 million tons of hydrogen fluoride. In Iceland alone, this gas killed crops everywhere. It is estimated that nearly 20 to 25 percent of the population died of the famine that followed. It also messed up the rainfall in India, ruining the monsoon seasons for years to come. This caused the decline of crops, and subsequently harsher rule by the British whose export business decline. People barely had enough to sell, leaving nothing for their own families. This is also said to be a part of the reason for the severe drought in Sahel. It also caused a thick poisonous haze to fall over Europe, killing thousands of people.

Significant mathematical progress during the Leonhard Euler's lifetime

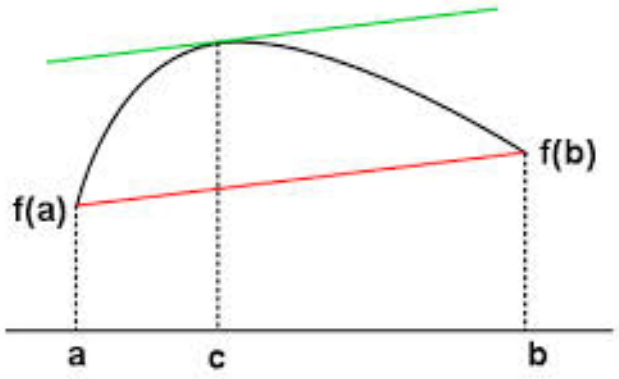
While Euler played a major role in the advances of mathematics of the 18th century, there were many others as well. The Bernoulli family dominated the math scene. They were primarily responsible for furthering the development of the infinitesimal calculus. Johann, the initial teacher of Euler, was able to prove through calculus abstract problem that did also have real world applications. One of these involved a ball rolling down a ramp, the object was to find the fastest way. Johann proved that neither a straight ramp nor one with a steep incline was the fastest way. Instead, it was the middle route, where a brachistochrone curve, like the path followed by a point on a bicycle path, was the way to go for the fastest speed. And while Johann was highly competitive and sometimes stole from his own son, he is still highly regarded for his work. Jacob Bernoulli also discovered the approximate value of the irrational number e while exploring the compound interest on loans.

This was a time when French was a time period of great mathematicians. One of them was Joseph Louis Lagrange. He also contributed to differential equations and number theory, and he is usually credited with originating the theory of groups. His name is given an early theorem in group theory, which states that the number of elements of every sub-group of a finite group divides evenly into the number of elements of the original finite group. Lagrange is also credited with the four-square theorem, that any natural number can be

represented as the sum of four squares

$$3 = 1^2 + 1^2 + 1^2 + 0^2$$
$$31 = 5^2 + 2^2 + 1^2 + 1^2$$
$$310 = 17^2 + 4^2 + 2^2 + 1^2$$

He also made the Mean Value Theorem, which states that, given a section of a smooth continuous (differentiable) curve, there is at least one point on that section at which the derivative (or slope) of the curve is equal (or parallel) to the average (or mean) derivative of the section.



Another mathematician, Pierre-Simon Laplace, believed that there had to be a set of scientific laws that predict how the entire world must work and what will happen. He focused most of his work on differential equations and finite differences. He made theories on the mathematical and philosophical concepts pertaining to the probabilities of the world. He translated the geometric study of classical based mechanics to those based more calculus in his book, Celestial Mechanics. This allowed the mathematics to be expanded for a much larger areas. Due to this, mathematics expanded well beyond what they once were.

Adrien-Marie Legendre made important contributions to statistics, number theory, abstract algebra and mathematical analysis. And while a majority of his work on least squares method for curve-fitting and linear regression, the quadratic reciprocity law, the prime number theorem and his work on elliptic functions was only perfected by others, his work is still quite important. He created the textbook, Elements of Geometry. This would go on to become the best textbook on geometry for the next 100 years. He was also indirectly responsible for the creation of the metric system of measures and weights.. His measurements were so accurate of the terrestrial meridian that they became the basis for it.

Gaspard Monge was the founder of descriptive geometry, a method in which one could present three dimensional objects on a two dimensional place. He was made a physics professor at only 17. Originally his work seemed to have no practical uses, and he was disgusted by it. However, he found a way to use them for the optimization of fortifications of the defenses. Now it has a commonplace use in engineering, architecture and design. It is the graphical method used in almost all modern mechanical drawings.

Johann Lambert's work was based off the work off of past people, however it is a very important result. He was able to prove that pi is an irrational number and that it cannot be in any way, expressed as a simple fraction using only integers. repeating nor terminating decimals. This somehow only made the craze of doing

so, greater. Lambert was also the first to introduce hyperbolic functions into trigonometry and made some prescient conjectures regarding non-Euclidean space and the properties of hyperbolic triangles.

Connections between history and the development of mathematics

The 18th century was the spark of the enlightenment period in many countries. There were incredible advancements in all fields of sciences, and mathematics. People began to question the status quo in many countries, rather than just blindly following the church or government. While revolts were always happening by the poor, this is the beginning of when they were done by the middle and upper class, or esteemed citizens of that time period. This was the period of academies being formed for the sole purpose of furthering the knowledge. They were funded by the country and mathematicians had high standing in the society.

Mathematics is done with either a practical or theoretical use in mind. While countries wanted mathematics that would further the engineering progress in the world, a lot of math was used to prove theorems, or theories from the past. These advancements went on to create more and more fields of mathematics to the point where it was considered impossible to be knowledgeable of all mathematics. This stretch of time is known as the explosion of mathematics, and governmental funding played a major role in this. Also, with the advancements in technology, and increased global communication, mathematicians were finally able to communicate with each other. The time of them working by themselves was ending. While some chose to work in secret, a more general time of collaborations was upon them.

Remarks

The 18th century was one of great changes. This is the century full of advancements, wars, enlightenment and the fall of Empires. Throughout all this, mathematics has stood the test of time. In fact it was one of the most renewed and expanded upon regions. Entirely new areas of mathematics were formed. While the world was in turmoil, math and science carried on like nothing was wrong in the world. And one may say that the 18th century only had minor advancements in practical mathematics, there is no way to contest that mathematics would be the same without this time period. It was truly a period of major developments.

Leonhard Euler is an incredible man. While he may not have a rags to riches story, he lived in a period of time marked by constant warfare, and he still managed to become one of the more published mathematicians ever. This is not the son of a famous mathematician, his father and mother were both highly religious, something that they passed on to him. And while that may have caused him a few issues in Berlin, it ultimately lead to his return to Russia, a place where he was happier.

He is known for many things, but I think the most notable should be teaching the German princess. She had little to no formal teaching in mathematics, but he was able to put his work, and others, in terms that she could understand. Euler had a gift of being able to teach abstract, advanced ideas to the common masses. In today's terms, he would have been a great teacher. It is a gift to be brilliant, no doubt, but that brilliance is considered a loss if no one can understand it. Euler managed to have both of those skills, making him one of the most remarkable mathematicians ever. I think a lot of that was due to his childhood, rather than being raised in a world of luxury, he was what would be considered now as middle class. He was a very grounded man and it greatly influenced how his interactions with others were shaped.

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