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William R. Wade, Major Professor

We have read this thesis and recommend its acceptance:

Charles Collins, Philip Schaefer, Mary Sue Younger

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

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THE ORIGINS OF MATHEMATICAL SOCIETIES AND JOURNALS

A Thesis Presented for the
Master of Science
Mathematics
The University of Tennessee, Knoxville

Eric S. Savage
May 2010

ABSTRACT

We investigate the origins of mathematical societies and journals. We argue that the origins of today's professional societies and journals have their roots in the informal gatherings of mathematicians in 17th century Italy, France, and England. The small gatherings in these nations began as academies and after gaining government recognition and support, they became the ancestors of the professional societies that exist today. We provide a brief background on the influences of the Renaissance and Reformation before discussing the formation of mathematical academies in each country.

TABLE OF CONTENTS

Chapter Page

CHAPTER I

Historical Background

Introduction

Modern universities (especially those in the United States) use seminars as a regular part of the graduate degree process in mathematics. They are a way that one person introduces and discusses new problems with others in an informal setting while training graduate students in the methodology of research. Students are also encouraged to join and become active members in a professional organization in mathematics such as the American Mathematics Society. In order to stay up to date on current research and discoveries, active mathematicians regularly read journals that contain mathematics and applications in their specialty. Where did the idea of seminars and professional organizations begin? Who first saw the usefulness of mathematicians coming together to meet and discuss their research?

We will argue that partial answers to these questions can be found in 17th century Italy, France and England. Since these countries were the intellectual centers of that time, it is only natural that their scientists were the first to meet in small groups to discuss mathematical problems. These small groups, which were led by one or two individuals, were known as academies. After gaining government support, they became recognized organizations and are the ancestors of the professional societies that exist today. But two of these countries played a lasting role whereas one did not. We will argue that geopolitical forces explain that difference.

Movement Away From Universities

One naturally expects that the universities in the 17th century were the centers where the intellectual elite first came together and met in person. But until the mid 17th century, universities were primarily engaged in training priests. What little technical material found its way into their curriculum was very elementary, for example, basic mathematical skills used by tradesmen and merchants. The universities remained “conservative and dogmatic, controlled by the official religions” and were slow to include new scientific discoveries in their curriculum.[1]

Administrative positions were held by theologians who insisted that professors follow church doctrine and forbid scientific thought that contradicted the church.[2] In France, professors had to be devout Catholics who kept students focused on their religious duties.[3] The taking of holy orders was required for all

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[1] Morris Kline, *Mathematical Thought from Ancient to Modern Times* (New York: Oxford University Press, 1972), 397.

[2] Martha Ornstein, *The Role of Scientific Societies in the Seventeenth Century* (Chicago: University of Chicago Press, 1938), 213.

[3] Ornstein, 220.

professors in England until the founding of the Lucasian professorship at Cambridge in 1663.[4] After Galileo was condemned by the Roman Inquisition in 1616, universities became even further separated from developments and successes in scientific inquiry.[5]

Now, it is true that during the 17th century, the more progressive universities began to develop a limited scientific curriculum which went beyond basic math skills. But even then they only taught the material of Aristotle and other Greek authorities with the belief that nothing else was left to be discovered.[6] With this prevailing philosophy, it comes as no surprise that the most prominent 17th century scientists (or philosophers as they were referred to then) rarely taught at universities. Examples of first rate mathematicians and scientists who never held a university post include Bacon in England, Huygens in Holland, Leibniz and Kepler in Germany, and Descartes and Pascal in France.[7]

Mathematical Motivations in the 17th century

Many new mathematical ideas were introduced from the 17th century onward. There are two primary reasons for this. First, as scientific inquiry led to the discovery of new ideas, scientists used mathematics to explain their discoveries. Moreover, real world applications also required new mathematical ideas and methods. This was especially true for the creation of new instruments and the explanation of universal laws.

Another driving force behind the development of new mathematical ideas was the significant increase in exploration and merchant travel across the ocean. Navigation required improved methods to determine latitude and longitude which, in turn, required more accurate measurements of the position of the sun, moon, and stars. Although Kepler's planetary laws gave better results, they did not have a solid theoretical foundation. They were developed by fitting observed data, not by discovering the laws of motion. As Kepler, Galileo, and Torricelli began to study the laws of motion and the functions required to explain these laws, they improved the tables used by sailors to calculate their positions when at sea.[8] Astronomy also led to a study into the properties of conic sections and their projections.

A good example of how scientific curiosity led to new mathematics is provided by Fermat, Descartes, and Huygens who were interested in the study of optics in order to design and grind more effective lenses. The optics of the microscope and the telescope, both invented in the early 17th century, renewed an interest in the study of curves, surfaces, and geometry which formed the theoretical basis of optics.[9]

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[4] Kline, 398.
[5] Ornstein, 32.
[6] Ornstein, 214.
[7] Ornstein, 257.
[8] Kline, 336-338.
[9] Kline, 285-286.

Another example is the progress made in explaining ballistics. This led to a study of curves, specifically their maximums and minimums, and range. Both of these endeavors supported development of calculus, specifically for the use of the tangent.

The arts also provided motivation for mathematics through the use of perspective. Just as scientists studied the laws of nature, artists began to study the laws of perspective in order to capture more realism on their canvases. As they took three dimensional objects they saw and recreated them on two dimensional surfaces, they opened the door to a new form of geometry. Desargues, Pascal, and La Hire all studied the Euclidean geometric principles of projection, sections, and points of infinity in what is now called projective geometry.[10]

Shift to inner logic

Applications did not always drive mathematical discovery. As these applications generated more mathematical ideas, the ideas themselves led to more discoveries. Perhaps the best example of this is provided by the study of power series.

In the 17th century, the quest for using power series to unify functions the way decimal expansion had unified numbers led to many results which did not have obvious applicability. Results like these caused a shift in intellectual thought to begin in mathematics. Boyer says that mathematics developed, not always from “economic, social, or technological forces” but because of an “inner logic.”[11] This “inner logic” refers to the fact that mathematics provided new ideas for mathematics that did not have an immediate application in the real world.[12]

Examples of this are provided by the work of James Gregory, Bonaventura Cavalieri, and Blaise Pascal. James Gregory used known convergent power series to create other series that converged faster which made it easier to calculate logarithms.[13] Cavalieri’s method of indivisibles was a precursor to modern calculus since it used the idea of an infinite number of ordinates to calculate the area between two curves.[14] Pascal also aided in the formation of modern calculus with the use of the Greek method of exhaustion and the idea of limits (although not well defined at this time). Using known results on the sum of the powers of the *n* natural numbers, Pascal was able to approximate the area under a curve using a finite number of rectangles whose width grew smaller.

Since these problems are theoretical and not obviously useful, we see that although applications of mathematics in the real world continued to affect mathematics, they were not always the primary motivation for further study.

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[10] Kline, 286-290.

[11] Carl Boyer, *A History of Mathematics* (New York: Wiley, 1968), 368.

[12] Kline, 393.

[13] Kline, 438-439.

[14] Kline 349-350.

Power series were, and continue, to be a major tool in both the theory and applications of analysis.

Influence of the Renaissance

The rebirth of classical studies during the Renaissance, which occurred during the late 15th century and the 16th century, brought forth a resurgence of interest in examining and understanding the physical world. Since the works of Plato and Pythagoras had placed an emphasis on how logic and the quantitative reasoning of mathematics could be useful to understand nature, this world view was gradually adopted by scientists during this period.[15]

This new world view had profound effects on the intellectual community, especially on scientific thinking. Philosophers not only translated the classics, but also began to publish new results. As they began to use the vernacular, more and more people began to participate, which spread the new ideas even faster.[16] Some of the mysticism within the classics was also revived and led to great discoveries in the 17th century. The laws of planetary motion stated by Johannes Kepler were precipitated by a mystical belief that the motion of the planets is rooted in the five regular solids.[17]

Influence of the Reformation

The Protestant Reformation shook medieval society to its core. The church, which had been a source of stabilization and a unifying force in society, had held most of the political power. When the Reformation threatened this power, the church fought back. Scientific progress was sometimes met with harsh criticism and even persecution by church leaders, since it did not coincide with Church doctrine and supported the Reformist's position that the Catholic Church did not contain the real truth. In order to stop the spread of reformed thought, censorship increased and punishments such as exile, excommunication, and death were handed out. This forced scientists, especially those in Catholic controlled countries like France and Italy, to hide or delay revealing their results in fear of persecution and rejection. Even philosophers in countries where the Reformation succeeded still used caution when publishing, although such censorship was not as severe. [18]

One of the most notable examples of persecution is that of the Italian scientist Galileo Galilei who was excommunicated and placed under house arrest after openly expressing his belief in a heliocentric universe rather than the Church's geocentric theory. Because of this persecution some adopted a cagier strategy for announcing radical ideas.

The famous French mathematician René Descartes believed his theory of vortices to be true, but published his results as "theory" rather than "fact" to avoid censorship. The Church sensors were not fooled and his works were placed on

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[15] Kline, 218-219.

[16] Allen Debus, *Man and Nature in the Renaissance* (Cambridge: Cambridge University Press, 1978), 6.

[17] Debus, 94-95.

[18] Andrew Pettegree, *The Reformation World* (London: Taylor & Francis Routledge, 2000), 528.

the Index of Prohibited Books and remained there until about a century after his death.[19]

The most successful and influential thinkers of the 17th century had to break away from staying solely within the context of the classics and, at the same time, those in Catholic dominated countries had to contend with the restrictions the Church placed on scientific thought. To avoid persecution from publishing books which would be deemed "against the Catholic Church," some authors used a pseudonym to disguise their identity.

When the first societies met and published results, how did they avoid persecution and punishment? To answer this question, each country must be discussed individually. Italy contained the Holy See, the central power of the Catholic Church. Being so close, forced many Italian societies to struggle or close once a member was punished by the Roman Inquisition. Just the opposite occurred in England where the Church of England held power since 1534. Although holding on to some Catholic doctrine, the Church of England was not controlled by Rome and was therefore open to Protestant reforms. The issue in France was more complex than Italy and England.

France began limiting the power of the church as early as the 15th century. In 1438, Charles VII of France limited Roman influence through the Pragmatic Sanctions of Bourges which allowed churches to elect their pastors rather than having one appointed to them by the papacy in Rome. A century later, Francis I made a concordat with Pope Leo X that went further and placed French clergy under royal control.[20] After the Protestant movement emerged, France continued this enlightened view for a while. For example, in 1598, Henry IV issued the Edict of Nantes which granted religious freedom, participation in government by Protestants, and removed the Inquisition.[21] However, by the 16th century, a war had broken out between French Catholics and Huguenots (French Protestants). This war was more political than religious in nature because although the Edict of Nantes had granted freedom and territory to Protestants, the more radical Protestants were not pleased with the growing central power of the crown. The Peace of Alais brought an end to hostilities, restored religious freedom to Protestants, but stripped them of political rights and control over all their cities.[22] In the end, this had a beneficial effect on France. Since Catholic doctrine was not enforced, it seems likely that scientific discoveries by French societies were tolerated because they attacked religious beliefs rather than royal authority.

Another consequence of the Reformation was a change in the dynamics of thought. All people, not just those with formal educations, began to question their religious beliefs and as an extension, they also began to question what they understood about the world around them. During this time, the pursuit of worldly knowledge became more common for all of society and not just one class.[23] The

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[19] David M. Burton, *The History of Mathematics: An Introduction* (New York: McGraw-Hill, 2007), 379.

[20] Victory Duruy, *A Short History of France* (New York: T.Y. Crowell company, 1929), 244, 302.

[21] Duruy, 375.

[22] Duruy, 393.

[23] Harold Hartley, *The Royal Society, its Origins and Founders* (London: Royal Society, 1960), 4.

pursuit of knowledge was no longer restricted to scientists and the elite. Merchants, craftsmen, and laborers were also asking how the world operated and contributed their answers through societies like the Royal Society of London.[24]

It would be a mistake to think that the Protestant scientist were secularist who had rebelled against any religious thoughts. In fact, Protestant scientists of that era often viewed their work as an outward symbol of inner religious devotion. Believing that God created the universe with a mathematical design, the discovery of mathematical laws to explain the universe meant studying God and understanding His plan for the universe.[25]

Scientists realized that the teachings in the classics and observed data did not always agree with the teachings of Christianity and the doctrines of the church, but they also soon realized that deductive reasoning alone was not sufficient to derive all relationships between the observed data and God's plan.[26] For example, Descartes attempted to use reasoning alone to explain the universe when he introduced his vortex theory in 1644. Although it explained the universe in laymen's terms it lacked support from experimental data and contradicted many known celestial phenomena.[27] A new method required sound arguments that could be tested and provide verifiable facts which did not rely on deducted conclusions alone. As a result, a slow change in scientific development began during the Reformation that augmented deductive reasoning with experimentation. Mathematicians, caught up with this idea, also began to experiment with concepts, such as derivatives and power series, that were not as logically precise as Greek mathematics. But experimental mathematics energized the whole field.

Italian attempt at societies

In the previous paragraphs, we saw that the prevailing philosophical mood and the geopolitical forces of the 16th century and early 17th century had reignited the study of the natural world. Widespread interest in understanding nature precipitated the formation of scientific societies, essentially clubs where interested people gathered together to discuss their discoveries and the latest developments in science. The Italians were the first to attempt the creation of scientific societies. The first organized academy for science began in 1560 in Naples under the direction of a nobleman named Giambattista della Porta. His Accademia Secretorum Nature consisted only of those who had contributed unknown discoveries on the laws of nature. [28] In 1601, Duke Federigo Cesi gathered three other men at his home and began the Accademia dei Lincei in Rome with a mission to experiment and share the results in public in order to defeat ignorance about scientific truths. Eight years later, they reorganized and

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[24] Ornstein, 111.
[25] Kline, 219.
[26] Pettegree, 525-526.
[27] Burton, 377.
[28] Burton, 498.

grew to 32 members including della Porta and Galileo, who provided leadership and notoriety to the struggling society. They studied nature, not as individuals, but as a group and shared their results in public by publishing books for sale although many were not bought. The Accademia dei Lincei is most famous for having a member give the names “microscope” and “telescope” to Galileo’s instruments. [29] The final Italian scientific society founded in the 17th century, was in Florence. The Accademia del Cimento (Experiment) was begun by the brothers Ferdinand II and Leopold Medici in 1657. The Medici brothers were students of Galileo as were two leading members of the society, Viviani and Torricelli. They emphasized observation and experimentation and the continuous improvement of the measuring instruments they used in their laboratory.

None of these societies lasted long, because of the deadening effect of the Roman Inquisition. However, the concept they pioneered became a model for other countries to follow.[30] Believing that the members of the Accademia Secretorum Nature practiced magic, the Catholic Church summoned della Porta for questioning and although never charged, he was forced to close the academy.[31] The Accademia dei Lincei disbanded after Galileo faced the Roman Inquisition in 1630 and did not open again until 1801.[32] When Leopold Medici became cardinal in 1667, he could no longer support the Accademia del Cimento and it was forced to close.

All of these societies shared their results in public, first in the form of books, then pamphlets in order to make them affordable to the public. The Accademia dei Lincei published their proceedings under the title Gesta Lynceorum and allowed its members to use the title of Lynceus, seen especially in Galileo’s work. The secretary of the Accademia del Cimento, Lorenzo Magalotti, published at least 14 accounts of their experiments and sent copies to other countries for translations.[33] Although these academies concerned themselves with scientific experiments and observations, they were a prelude to the mathematical societies and journals that developed and prospered in France and England.

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[29] Ornstein, 74-76.
[30] Ornstein, 73.
[31] Burton, 498.
[32] Burton, 498.
[33] Ornstein, 76-90.

CHAPTER II

Mathematical Societies of France

Marin Mersenne, who was born in 1588 in the province of Maine, France, was a monk of the Minimite order and an able scientist.[34] Although Galileo and the other Italians formed the first scientific societies, Mersenne was the first to create a lasting society whose descendant still functions today. Mersenne's society was also the first to focus not only on science, but to include the discussion of problems in the field of mathematics. I argue that he did so because of his personal interest in the sciences, the influence of his mentor Jacques Mauduit, his personal search for truth, the work of his contemporaries, and the fortuitous time in which he lived.

Marin Mersenne: The Minimite Monk

Educated at the Jesuit school at La Flèche and then at the Sorbonne in Paris, Mersenne joined the Order of the Minims in Paris where he did most of his work.[35] Besides publishing a number of works on religion he contributed to the fields of optics, acoustics, and mathematics.[36] In acoustics, he expressed the quantitative relationship between the frequencies of vibrating strings, their tension, their length, and other physical characteristics.[37] In physics, he used his love of music to devise a number of experiments to measure the speed of sound. His contributions in mathematics were primarily in number theory. He worked on the factorization of binomial numbers and the prime factorization of integers of the form $2^n - 1$, which are now known as Mersenne numbers.[38] Mersenne also studied the classical problem of perfect numbers.

Although a number of his conjectures on perfect numbers were incorrect, his legacy continues with Mersenne primes which, as Euclid proved in Book IX of the *Elements*, can be used to generate perfect numbers.[39] In Mersenne's lifetime, only seven Mersenne primes were known to exist. The next five were discovered over a course of almost three hundred years.[40] With the aid of computers, starting in 1952, a total of 47 Mersenne primes are now known. The last thirteen, which were all the largest known primes at their discovery, were found through the Great Internet Mersenne Prime Search (GIMPS), which, even today,

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[34] Robert Watt, *Bibliotheca Britannica*, vol. 2 (Edinburgh: Archibald Constable and Co., 1824), 666.

[35] Vere Chappell, ed. *Grotius to Gassendi: Essays on early modern philosophers*, vol. 2 (New York: Garland Publishing, 1992), 95.

[36] Chappell, 95.

[37] Chappell, 101.

[38] Oystein Ore, *Number Theory and its history* (New York: McGraw-Hill Book Co., 1948), 70-71.

[39] Burton, 504.

[40] Ore, 72-73.

continues to search for the next Mersenne prime. Large primes are important to Internet security because they are used for some methods of encryption.

Mersenne's greatest contribution to both the mathematical and scientific world was due to his unquenchable thirst for knowledge. This manifested itself in two concrete ways: he founded a lasting society that held regular meetings to gather and discuss scientific and mathematical ideas in person and he maintained a regular and massive correspondence with other mathematicians and scientists throughout Europe.

Jacques Mauduit and the music academies

What motivated Mersenne to begin his academy? To answer this question, we digress to discuss Mersenne's teacher and close friend, the musician Jacques Mauduit.[41] During the 16th century, some non-scientific academies had already formed, mostly language academies to promote the study of the classics in the translated versions (in this case, translated into French). Mauduit was part of a famous academy that developed for the sole purpose of developing musical knowledge. The Baïf Academy, named for its founder, Jean-Antoine de Baïf, not only worked to develop music, but reinvented the music of the classics and applied it to worship music.[42] As a young boy, Mersenne fell in love with music and became a student of Mauduit. Seeing how effective an "academy" was for music it was only natural that Mersenne eventually thought of applying this idea to mathematics and science. Frances Yates corroborates this thought when he says that:

> "musical humanism, with its intense preoccupation with questions of "number" and "measure," may have played a part in that development of the mathematical approach to physical science"[43]

So from a 16th century emphasis on music, we come to a 17th century focus on science and mathematics, with Mersenne as the link that connects these two thoughts.

The correspondence of Mersenne

Why was Mersenne so committed to regular correspondence? When Mersenne began to study mathematics seriously in 1619, he quickly realized it was advantageous to consult with other mathematicians on various problems.[44] He began to contact known mathematicians in other cities and other countries. This correspondence continued his whole life, and was responsible for

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[41] Frances Amelia Yates, *The French Academies of the Sixteenth Century* (London: London Warburg Institute University of London, 1947), 24.

[42] For more on the Baïf academy and Mersenne's musical theory, see Yates, 14-35.

[43] Yates, 104.

[44] Chappell, 95.

disseminating results as they were discovered rather than letting them die with their creators or waiting for them to be published in a book.

Mersenne's academy developed out of his vast network of correspondence with all the prominent scientists of his time. He tirelessly passed on and shared information with his correspondents in exchange for news and ideas coming out of other countries. Through his letters Mersenne crossed international boundaries and helped bring several people together who were working on the same problem. He had regular correspondence on probability theory with his fellow countrymen Pierre de Fermat and Blaise Pascal and with Christiaan Huygens of Holland. He translated some of Galileo's work into French and communicated with Galileo's most promising student, the Italian Evangelista Torricelli, on his work on vacuums. He also wrote to John Pell and Thomas Hobbes of England and to at least 78 known philosophers and scientists throughout Europe. Burton says that in doing so he "fulfilled many functions of a modern scientific journal." [45] Mersenne's network of correspondents eliminated duplication and time spent on problems that were already solved. For problems that still remained unsolved, Mersenne stimulated rapid advances by bringing different people and their points of view to bear on a single problem. In particular, Mersenne made it his personal duty to connect and bring together the giants of the intellectual world in order to organize and share their discoveries.

Although he did not provide much on his own, in his letters, Mersenne asked questions and shared results to encourage feedback.[46] It is here that we see Mersenne's greatest contribution as a catalyst of thought. When Descartes visited Paris in 1612, he met with his childhood friend, Mersenne, who reignited his passion for mathematics and spent the next two years in serious research.[47] It was Mersenne who encouraged Gilles de Roberval to study the cycloid, which Mersenne had learned from Galileo. Six years after Mersenne first suggested the problem, Roberval computed the area of a loop of the cycloid (the quadrature problem), knew how to get the exact value of the slope of the tangent line to the cycloid at a general point (drawing of tangent lines), and could calculate the volume of the solid formed when the cycloid was rotated.[48] After Mersenne learned of Roberval's results, Mersenne shared these results with Descartes and Fermat in the form of a challenge rather than delivering a straightforward result. In doing so, Mersenne received an independent confirmation, but also encouraged and facilitated the thinking of others.

We see another example of Mersenne's inspiration in Christiaan Huygens' work on pendulums. When Huygens expressed his desire for a more accurate clock, it was Mersenne who suggested the use of the pendulum as the timer.[49] From here, Huygens proved the cycloid was a tautochrone, a curve in which the time taken by a particle, affected only by gravity, to reach the lowest point is the

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[45] Burton, 500.

[46] Burton, 499.

[47] Burton, 364.

[48] John Martin, "The Helen of Geometry," *The College Mathematics Journal* 41, no. 1 (2010): 18-20.

[49] Martin, 22.

same regardless of its starting point. He then constructed a clock whose pendulum had the same period, independent of the amplitude.[50]

Mersenne's ability to recognize talent and encourage thought has not gone unnoticed by Boyer who claimed that had, "Mersenne lived a century earlier the delay in information concerning the solution of the cubic might not have occurred, for when Mersenne knew something, the whole of the 'Republic of Letters' was shortly informed about it."[51]

Through his correspondence with Galileo, it is unlikely that Mersenne was ignorant of Galileo's participation in the early Italian scientific societies. He was also aware of how the Italian societies fostered scientific development despite their brief lives. This knowledge and the influence of Mauduit's participation in the 16th century Baïf academy probably motivated Mersenne to form his own scientific academy to discuss serious topics of the day in an informal manner.

Mersenne's academy

During his lifetime, Paris grew into an intellectual center for scientific progress and so Mersenne began inviting his contemporaries to gather at his cell. They came together to discuss, "astronomical observations, problems of analysis, physical experiments, new discoveries in anatomy and botany."[52] Mersenne's "academy" became a regular stop for intellectuals as they passed through.[53] Descartes, Desargues, Le Pailleur, Roberval, Carcavy, Mydorge, Étienne and Blaise Pascal are just a few of those who met with Mersenne.[54]

Mersenne was also adept at finding talented young scientists and encouraging them, including the young genius, Blaise Pascal. In one noted gathering of Mersenne's group, the then 16-year old Blaise Pascal presented a one page paper on his work with conics that contained some theorems on projective geometry and included his mystic hexagon theorem.[55]

This academy had regular meetings from 1635 until Mersenne's death in 1648.[56] The "Mersenne academy" however, outlived its founder, meeting at the homes of Pascal, Hubert de Montmort, and Melchisedec Thevenot.[57] As their numbers grew, they developed into the Académie des Sciences, founded in 1666 with the support of King Louis XIV.[58] Although similar academies were formed in Paris and elsewhere in the 16th and early 17th century, Mersenne's was the first to place a heavy emphasis on the discussion of mathematics.[59]

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[50] Martin, 23.

[51] Boyer, 334.

[52] Ornstein, 142.

[53] Yates, 285.

[54] Émile Cailliet, *Pascal: Genius in Scripture* (Philadelphia: The Westminster Press, 1945), 42-43.

[55] Burton, 448.

[56] Burton, 500.

[57] Ornstein, 142-144.

[58] Kline, 396-397.

[59] Burton, 500.

The influence of Cardinal Richelieu

Unlike the scientific societies in Italy, the Mersenne academy and others like it flourished in 17th century France. While Mersenne was a driving force for the rise of scientific societies in France, he was fortunate to live in a time that supported the growth of scientific societies. As discussed in Chapter One, the French government tolerated reformed thought more than Italy. In 1635, Cardinal Richelieu, the prime minister of France, understood the benefits of academies to help transition France from the crudeness of medieval society to the civility of a kingdom. Because of this, he founded the Académie Francaise to promote language skills and transform men from warriors to gentlemen.[60] As a philosophical monk who was known for his letter writing, it seems likely that Mersenne was involved with the Académie Francaise in the development of language for the use of philosophers.[61] The Académie Francaise also housed the royal printing house that gave Mersenne and other scientists (especially those who were members of the clergy) access and availability to publish their findings. Although the material could not openly undermine the teachings of the church, Mersenne especially had a unique skill in defending controversial ideas for their usefulness in providing accurate calculations, but not as matters of faith.[62] With his skillful writing and the protection and security of Cardinal Richelieu, Mersenne slowly and safely presented new ideas that were true to scientific thought, but seemed to conform to the doctrines of the Church. The importance of Mersenne's diplomatic skills and Cardinal Richelieu's power can be seen by examining what happened to science in Italy. No permanent society was formed until the Accademia Nazionale dei Lincei in 1870 and the earliest Italian mathematical journal that still exists today was the *Rendiconti Lincei – Matematica e Applicazioni* which began in 1884.

A devout monk who was tolerant

Although scientific progress was sometimes met with harsh criticism and even rejection by church leaders in countries dominated by the Catholic Church, Mersenne was not dissuaded. He promoted the sciences since he saw science as a means to prove and grow closer to God in mind and spirit.[63] Mersenne was devout in his beliefs, but remained open to new ideas, which is evident in two ways. The first was his application of what he called unproven theories, like the Copernican theory, for their effectiveness in predicting eclipses and locations of planets. He did not support it as a religious doctrine, but rather as a convenient

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[60] Geoffrey Russell Richards Treasure, *Cardinal Richelieu and the Development of Absolutism* (London: A. and G. Black, 1972), 249.

[61] Peter Robert Dear, *Mersenne and the Learning of Schools* (Ithaca: Cornell University Press, 1988), 171.

[62] William Hine, "Mersenne and Copericanism," *Isis* 64 no. 1 (1973) 18-32.

[63] Yates, 286.

tool to aid in applications.[64] The second piece of evidence that he was open to new ideas was that he had numerous friends among the Reformers and that he could be influenced by someone he called a heretic, the English scientist, Francis Bacon. Both had ideas on a system of experimental science that both solidified scientific results and aided in the progress of mankind.[65]

While Mersenne was not the first to form a scientific society, his was both the first to place a strong emphasis on mathematical topics and the first scientific society to prosper. His academy became a model for other societies (for example the Royal Society of London) to duplicate. While his society was the work of his own hand, its ability to prosper and grow was a product of the time and people surrounding him. His simple gathering and personal thirst for knowledge formed one of the earliest scientific societies that still exists today.

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[64] Hine, 31.

[65] Yates, 287.

CHAPTER III

Mathematical Societies of England

In the 17th century, England also began one of the most well known academies ever founded, The Royal Society of London for the Improvement of Natural Knowledge (simply known as the Royal Society). The creation of the Royal Society was partly an imitation of Mersenne's ideas, but its formation was also due to the desperate times of 17th century England, the philosophical teachings of Francis Bacon, the correspondence of Theodore Haak, the leadership of John Wilkins, and the professors of Gresham College.

The English Civil War

In the first half of the 17th century, England was in the middle of a brutal civil war that brought destruction of cities as well as famine and disease. The war was not motivated so much so by class and economics, but rather by who should rule over England. Charles I believed he was ordained by God to rule while Parliament believed they were to rule by the will of the people.[66] After removing the monarchy by force in 1653, England was left with a weak Parliament that soon fell under the military hand of Oliver Cromwell during the Protectorate years. Cromwell and his Parliament never agreed on a path the country should take so Cromwell disbanded Parliament and used force to obtain what he wanted. He did not support those who placed him in power, which weakened his control. After dying from an illness in 1658, Cromwell's son Richard took the title of Protector. The army did not support Richard, overthrew him in 1659, and reinstated Parliament.[67] This development failed to solve the underlying problems, and eventually the Stuart monarchy was restored when the exiled Charles II was crowned King of England in 1661.[68] Although the civil war was over, this was still a time of fear and anxiety caused by the spread of the Bubonic Plague.

This dreadful time for England served as a motivational tool for the founders of the Royal Society. By engaging themselves fully and devoting all their energy to their studies, they mentally escaped the troubles of their time. In his *History of the Royal Society*, Thomas Sprat says,

> "Their first purpose was no more, then [only] the satisfaction of breathing a freer air, and of conversing in quiet one with another, without being [engaged] in the passions, and madness of that dismal Age."[69]

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[66] Burton, 382.

[67] G. M. Trevelyan, *History of England* 3rd ed. (London: Longmans, Green and Co. Ltd., 1945), 416-430.

[68] Trevelyan, 446.

[69] Thomas Sprat, *History of the Royal Society* (St. Louis: Washington University Studies, 1958), 53.

The gatherings also provided hope in that they believed their work may help bring an end to the sufferings of man.

The teachings of Francis Bacon

Francis Bacon is well known for promoting what is today known as the scientific method. His primary goal was to develop a process that could easily be duplicated by others and arrive at truth by experiment. The idea was that numerous repetitions of scientific experiments by groups of scientists could verify some of the commonly held beliefs about nature as true, while exposing others as magic and legend. Specifically, Bacon promoted a hands-on approach of experimenting rather than the classical approach of arriving at the truth through mental cogitation and verbal debate. He stressed the importance of mathematics as a separate discipline because of its connection to science and the natural world and the immutability of its results. He encouraged the development of more formulas to support calculations, the use of tables for organizing scientific discoveries and the use of mathematical language and notation to describe these discoveries.[70] In this manner, Bacon went against traditional thinking and began a shift in intellectual thought. Sprat holds Francis Bacon as the epitome of all scientists who moved away from the way of the "Ancients" and began a new way to discover truth, namely by experimenting.[71] Although he may have not been directly involved with the meetings, Bacon is credited as being the "intellectual source" of the Royal Society.[72]

Predecessors of the Royal Society

The Royal Society also has its roots in the informal gatherings of scientists and learned men such as Mersenne on the European mainland, who founded other successful scientific societies. Indeed, Harold Hartley notes that Society records say that members of the Royal Society first met because other countries (France and Italy specifically) did so in order to promote learning.[73] David Burton confirms this saying, "several English scientists had visited the academies in Italy as well as the conferences of Mersenne and others, in Paris, and advocated forming a comparable organization in Great Britain."[74]

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[70] Margery Purver, *The Royal Society: Concept & Creation* (Cambridge: M.I.T. Press, 1967), 57.
[71] Sprat, 35-36.
[72] Purver, 75.
[73] Hartley, 1.
[74] Burton, 501.

The 1645 London club

One such group met in London under the direction of a German philosopher named Theodore Haak. He was not a scientist, but his linguistic skills allowed him to be a "promoter of scientific discussion and experiment."[75] Working with others in 1639, to create a college that Bacon said would be devoted to all studies, Haak began a correspondence with Mersenne in France.[76] The correspondence between Haak and Mersenne included Torricelli's vacuum experiment, one of the first experiments shared in Haak's club. Although the college never took shape, Mersenne and Haak exchanged numerous scientific results and books including results about the motion of water and about magnetism. By 1645 (ten years after Mersenne's first gathering), Haak had formed his own club in London whose goal was the sharing of experiments and news from elsewhere and not the sharing of personal work.[77] Haak's club is the earliest gathering of what became the Royal Society. This is noted by John Wallis, a noteworthy mathematician who studied calculus and geometry, when in a letter to Thomas Smith, Wallis credited Haak as being the first to suggest the gatherings.[78]

The Oxford Experimental Science Club

A second group was formed under the guidance of John Wilkins, an English clergyman and scientist, born in 1614.[79] His scientific works focused on astronomy and mechanics and he encouraged the common person to accept new scientific findings regardless of faith.[80] Although England was in a civil war during the first half of the 17th century, Wilkins gained political protection when he married the younger sister of Oliver Cromwell.[81] After the restoration of the English crown, Wilkins maintained his protected status due to the quality of his work and dedication to the Church of England. Due to his connections, Wilkins became an asset to the scientific minds of England as they came together. Around 1648, while warden at Wadham College (a constituent college of Oxford University), Wilkins began gathering men in Oxford to continue the informal discussions that he had participated in while in London.[82] The men he gathered "had begun a free way of reasoning."[83] They simply came together outside of the University to demonstrate experiments, share discoveries and free themselves

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[75] Pamela Barnett, *Theodore Haak, F.R.S.* (Hague, Netherlands: Mouton & Co., 1962), 7.

[76] Barnett, 38.

[77] Purver, 175.

[78] Ornstein, 93.

[79] Barbara Shapiro, *John Wilkins 1614-1672: An Intellectual Biography (*Berkeley: University of California, 1969), 1-12.

[80] Shapiro, 30.

[81] Shapiro, 111-112.

[82] Christopher Hill, "The Intellectual Origins of the Royal Society. London or Oxford?" *Notes and Records of the Royal Society of London* 23 no. 2 (1968): 145.

[83] Sprat, 53.

from the restrictions placed on them by the university.[84] As discussed in Chapter One, this is another example of how the universities did not contribute much to scientific thought in the 17th century. Following in the steps of Bacon, Wilkins served as a leader to facilitate and develop scientific thinking while not providing much original work on his own.

In 1651, Wilkin's group, now known as the Oxford Experimental Science Club, constructed a set of guidelines to regulate their meetings and set standards for admission.[85] These guidelines eventually became standards of the Royal Society. The Oxford Experimental Science Club continued to meet until 1658, when many of their members transferred to London. It was here that they continued their practice at Gresham College.

Gresham College

The immediate predecessor of the Royal Society involved the seven professors that ran Gresham College, a unique school in London, offering neither degrees nor classes. The Gresham professors devoted their time to research and presented their findings to others in a series of public lectures. The Gresham professors of mathematics and astronomy along with their friends had a history of informally working together outside of the College dating back to the start of the 17th century. The Royal Society modeled itself on this relationship.[86] It is highly likely that the gatherings at Gresham College, that formed the basis of the Royal Society, were a synthesis of Haak's London club, Wilkins' Oxford club, and the relationship among the Gresham professors.

The Royal Society begins

Although not by name, the Royal Society began on November 28, 1660 when the first formal weekly meetings began at Gresham College. A one-time entrance fee plus a weekly fee was established to help with the costs of experiments.[87] Members also earned money for the society by holding special lectures that were delivered to the public. In July 1662, these meetings took on the name of the Royal Society of London when they received their official charter and mace under King Charles II.[88] Charles II supported the Royal Society since the society emphasized the use of mathematics and the sciences to solve problems in "dyeing, coinage, gunnery, the refinement of metals, and population statistics," and to investigate topics in agriculture, astronomy, chemistry, and engineering among others.[89] With such a diverse field of study, one can even trace some of the applied studies of the Royal Society to the beginning of the

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[84] Sprat, 56.
[85] Purver, 111-112.
[86] Hartley, 7-8.
[87] Burton, 501.
[88] Burton, 501.
[89] Kline, 397. Sprat, 158-192.

16th century when there was an increase in currency and learning due in part by the development of “printing by movable type.” Although the royal charter did not provide funds for the society, the participation of Charles II, who enjoyed listening to their work and watching their experiments, attracted the greatest minds in England as participants.[90]

The actual meetings of the Society served as a way to reproduce and communicate the results of experiments.[91] Rather than merely discussing results, attendees actually watched while the experiment was demonstrated before them and verified the results. Instead of having all members work on the same experiment, individual work was emphasized. This allowed that “healthful emulation which is conducive to progress,” but also gave rise “to intense jealousies” usually in the form of priority disputes, both inside and outside the Royal Society.[92]

Newton and priority disputes

A central figure in these disputes was Isaac Newton. In 1672, the Royal Society elected Newton as a fellow of the Royal Society and he immediately published his works on optics. Newton’s work concluded that white light was composed of every color and that the colors appeared based on how much they bent (or refracted) as they passed through a prism. These results were contested by the Royal Society, especially by Robert Hooke, a founding member. Hooke believed Newton duplicated Hooke’s earlier experiment without giving due credit and drew conclusions that were not evident by the given experiment (Hooke said that Newton did not prove all the colors were in the light before the refraction, only afterwards).[93]

Another dispute between Newton and Hooke occurred when Hooke claimed priority on the inverse-square law of gravity. Newton had worked on gravity in 1667, but had abandoned his research when he discovered a discrepancy that he could not correct. When Hooke discussed the problem in private with the astronomer Edmund Halley, he refused to give a mathematical explanation. This prompted Halley to ask Newton if he could give a reason for the inverse-square law of gravitation. In order to answer this question, Newton resumed his previous work, eliminated the earlier discrepancy and published his results.[94]

Newton also had priority disputes with scientists outside of the Royal Society. The most famous is the controversy about the founding of calculus between Newton in England and Gottfried Leibniz in Germany. Newton shared his calculus, involving fluxions, with Isaac Barrow who shared it with John Collins, an English mathematician dubbed the “English Mersenne” due to his

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[90] David Ogg, *England in the Reign of Charles II* vol. 2 (Oxford: Clarendon Press, 1934), 722.
[91] Ornstein, 98.
[92] Ornstein, 91.
[93] Burton, 393-394.
[94] Ornstein, 137.

extensive correspondence. One person Collins communicated with was Leibniz. When Leibniz visited Collins in England in 1676, Leibniz read Newton's *De Analysi,* which contained parts of Newton's calculus. In doing so, Leibniz opened the door to be accused of plagiarism.[95] Eventually, the Royal Society appointed a committee to settle the dispute and ruled in Newton's favor.[96] The controversy took deep roots. The Royal Society was so adamant in their defense of Newton that the English intellectual community grew isolated and no longer served as a center for mathematical thought in the 18th century.[97]

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[95] Burton, 420.
[96] Burton, 427.
[97] Burton, 430.

CHAPTER IV
MATHEMATICAL JOURNALS

The Beginnings of Scientific Journals

The idea of publishing journals devoted to mathematics and science had roots in the development of newspapers and the rise of the scientific societies. Newspapers dating back to the seventh century, in China, started out as simple announcements posted at various times. It was not until the 15th century that newspapers published daily news, events, and government proceedings.[98] The gatherings of scientists, like Mersenne's academy and the Royal Society, called for a new method to spread the latest developments across great distances and with a growing number of scientists. The first scientific journals, the *Journal des Savants* and the *Philosophical Transactions* set a standard for the future dissemination of scientific information.

Journal des Savants

The first scientific journal, the *Journal des Sçavans*, was founded by Denis de Sallo de la Coudraye, a counselor of the French parliament who participated in a French academy led by Jean Baptiste Colbert, founder of the Académie des Sciences in France. As a participant in Colbert's academy, a descendant of Mersenne's academy, de Sallo was intrigued by the wealth of knowledge before him and hired copiers to reproduce and arrange the most significant results for quick reference. He then began the same process for the general public. The *Journal des Sçavans* had its first issue of twenty pages published on January 5, 1665 and included ten articles, plus some letters and notes. It previewed books, stated the results of scientific experiments, described new inventions, and announced current events of the time.[99] Early articles included a review of Hooke's *Micrographia*, a description of Roberval's balance, the invention and criticism of Newton's refracting telescope, and contributions from academies across the continent.[100] Although popular, the French government suspended its printing less than a year after it started when it published material that offended the crown.[101] It resumed publication at irregular intervals under the direction of the Académie des Sciences, until 1816 when it received its present name of *Journal des Savants*. A journal serving a similar purpose, but restricted to scientific work appeared in England only three months later.

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[98] Bernard Houghton, *Scientific Periodicals* (Linnet Books & Clive Bingley, 1975), 11.

[99] Houghton, 13-14.

[100] Ornstein, 201.

[101] A. J. Meadows, ed., *Development of Science Publishing in Europe* (New York: Elsevier Science Publishers, 1980), 5.

Philosophical Transactions

In 1663, Robert Hooke discussed with the Royal Society the creation of a regular publication containing the scientific discoveries of their body and others. Since nothing came from this discussion, Henry Oldenburg, secretary of the Royal Society, personally planned the publication of a journal for the Society using his correspondence with members of the Society and foreign scientists. With the approval of the Society, Oldenburg published the first issue of the *Philosophical Transactions* on March 6, 1665.[102] As the title page of the first issue suggests, the purpose of the *Transactions* was to "*[give] some concept of the present undertakings, studies, and labours of the ingenious in many considerable parts of the world.*"[103] In the first issue, three articles on optics all came from the *Journal des Savants*, which Oldenburg subscribed to in order to present findings to the Society. Other articles were about a calf made out of ore in Germany, whale fishing in the Bermudas, successful tests of pendulum clocks at sea for calculating longitude, and an obituary on Fermat who recently died.[104] Like the *Journal* in France, the initial upkeep and publication of the journal laid on the shoulders of its editor, in this case, Oldenburg. Despite financial hardships, Oldenburg maintained the publication yielding a very small profit. It was not until the 47th issue that the *Transactions* officially and financially came under the arm of the Royal Society.[105] The benefits of the *Transactions* were noted by the English botanist, Thomas Huxley a century later when he said that even if all the books of the world were lost, the foundation of science would remain because the *Philosophical Transactions* contained, "the vast intellectual progress of the last two centuries."[106] The *Transactions* served as a model for future journals published by academies and became a standard of how to publish scientific results.

Reasons why Scientific Journals prospered

Why was the work of De Sallo and Oldenburg successful? What made these scientific journals so interesting that other countries reprinted editions in their own country? Journals were successful because they satisfied a thirst for the latest knowledge and developments, presented scientific information in the vernacular, provided information in a concise form, and established priority claims.

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[102] Ornstein, 125.

[103] Houghton, 14-15.

[104] Harcourt Brown, *Scientific Organizations in Seventeenth Century France (1620-1680)* (New York: Russell & Russell, 1934), 200.

[105] Meadows, 7.

[106] Ornstein, 126.

Satisfying the thirst for new knowledge

As discussed in Chapter One, scientist in the 17th century realized that the classical authors like Aristotle did not have all the answers. Fielding Garrison said that “the vague seventeenth century appetite for new knowledge” was “aiming at no less than complete control of the best knowledge available.”[107] A journal was the perfect avenue to satisfy this appetite.

The idea was wildly successful beyond their dreams. After starting with only two scientific journals in 1665, there were 30 at the start of the 18th century, about 750 by the end of the 18th century and thousands by 1850.[108] As their numbers grew, journals began to adjust their content in order to reach a more specific audience. Between 1680 and 1689, there were 1,243 reviews in the *Journal des Savants* compared to 92 in the *Philosophical Transactions*. The *Transactions*, whose focus was on scientific news, published 1,898 papers and 600 book reviews from its inception in 1665 to 1700.[109] Of those papers, 542 (about 29%) were on the mathematical sciences.[110] During the next fifty years, the *Transactions* published 2,170 papers and 94 book reviews.[111] Of those, 502 (about 23%) were on the mathematical sciences.[112] The *Journal des Savants* also made changes in publication when during the periods of 1715-1719 and 1750-1759, the amount of scientific content grew from 29.1% to 45.3% and the amount of theological content decreased from 17% to 6%.[113] With so much information being shared, journal articles also allowed a continuous reexamination of scientific experiments and conclusions by peers when they attempted to duplicate or prove results.[114]

Printing in the local language

The use of the vernacular also contributed to the success of the scientific journal, especially among the general population. When scientists communicated with each other, especially across international borders, Latin was the “universal language” that was used. The treatises of scientists were almost always in Latin as seen by Kepler’s *Astronomia nova*, Mersenne’s *Harmonie universelle*, and Newton’s *Principia*. Descartes was the first to see how powerful the vernacular was in explaining complicated material to a wide audience.[115] In order to survive, journals needed to reach a wider audience since there were a limited number of

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[107] Garrison, Fielding, “The medical and scientific periodicals of the seventeenth and eighteenth centuries” *Bulletin of the history of medicine* 2 no. 5 (1934): 285-341.

[108] Meadows, 1.

[109] David Kronick, *A History of Scientific & Technical Periodicals* (Metuchen, NJ: The Scarecrow Press, Inc., 1976), 79.

[110] Philip George, “The scientific movement and the development of chemistry in England” *Annals of Science* 8 no. 4 (1952): 305.

[111] Kronick, 79.

[112] George, 306.

[113] Kronick, 46.

[114] Houghton, 19.

[115] Burton, 367.

scientists. In order to appeal to the general public, journals were written in the local language, since Latin was known only to those with formal educations. The *Journal des Savants* was the first to see the success of publishing in the vernacular when it was translated and reprinted in Holland starting in 1665 and in Germany in 1667.[116] The use of local languages allowed for the common person to participate in the scientific process and assist in the application of new discoveries.

The succinctness of articles

The journals also grew due to their publication of information in a condensed form available to a wide audience. Up to the 17th century, the primary method for spreading information had been through letter writing.[117] Letters were inefficient in that news was shared with only one person or a small group if there was a nearby academy. Books were not much better. They reached a wider audience, but they delayed the transmission of scientific information since the author had to wait until he had enough material to merit the publication of a book.[118] Although books reached more people than letters, the vast amount of detail a book must contain overshadows the results. Examples of this include Descartes' *Discourse* and Newton's *Principia*. The *Discourse* contained four parts and had an appendix, *La Géométrie,* which was over 100 pages on its own. Newton's *Principia* was a collection of three books with 53, 42, and 48 propositions respectively. [119] Journal articles, instead, provided those interested with the main points without having to read an entire book.

The establishment of priority

Another reason for the success of journals was their use in establishing priority for specific results. Letter writing and book publishing led to many disputes over dates of discovery because of the time it took to transform a manuscript into a book. These disputes led to the use of ciphers and anagrams to hide results until the publication of a book.[120] The publication of parts of a series of research was an incentive for scientists to support the development of journals.[121] Since there were still small delays between discovery of a result and its appearance in a journal, it was not uncommon for a scientist to present their findings to a learned body before publishing it in the society's journal, like the *Journal des Savants* of the Académie des Science.[122] It was also likely that a scientist would constantly publish their findings in the same journal to ensure

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[116] Houghton, 14.
[117] Kline, 396.
[118] Houghton, 12.
[119] Burton, 367, 403.
[120] Kline, 396.
[121] Meadows, 12.
[122] Burton, 501.

priority and notoriety.[123] This process was used by Gottfried Leibniz and Jacob Bernoulli on the continent with the *Journal des Savants* and the *Acta Eruditorum*.

The *Acta Eruditorum*, founded in Germany in 1682, was published in Latin in order to reach an international audience since German was not a popular language at that time. Publishing it in Latin helped it to become popular in the learned community because all scholars of that era read Latin. Leibniz shared most of his work in journal articles rather than in books. As a precursor to his work on the calculus, he shared results on infinite series including his series approximation for π (1674).[124] While his series required over 100,000 terms to be as accurate as Archimedes, his work led to the discovery of other series by James Gregory that were more efficient. It was in *Acta Eruditorum* that Leibniz published his version of calculus in 1684 and his work on integral calculus in 1686.[125] These and at least two dozen other works were translated and printed in the *Journal des Savants*. Most of the work was a continuation of his work on calculus including differentials of logarithms and exponentials (1692) and integration by partial fractions (1702).[126] Had the controversy on the discovery of calculus not occurred, it is likely that his works would have also appeared in the *Philosophical Transactions*.

Journals become a primary method to spread new ideas

To illustrate how popular these journals had become, we close by noting that the next generation of mathematicians used journals, rather than books, almost exclusively to spread their ideas. For example, Jacob Bernoulli, a student of Leibniz, published most of his results in journal articles rather than publishing books. Since he was living in Basel, Switzerland during this time, his best option to become well known in international mathematical circles was to publish in the journals of Germany and France. In these articles, he often challenged other mathematicians by proposing problems for which he already had a solution, many of which involved his work in the newly created calculus. For example, in 1690, he published a new solution to the tautochrone problem originally solved by Huygens. As discussed in Chapter Two, the tautochrone problem was to describe a curve in which the time taken by a particle, affected only by gravity, to reach the lowest point is the same regardless of its starting point. Huygens' solution was a long and tedious geometric proof that is unclear as to whether or not it worked. Using what is now first year calculus, Bernoulli expressed the velocity of the particle at any point as the derivative of its position. Using the conservation of energy, he calculated where the particle was at any given time (a differential or infinitesimal) and by using integration discovered the total time to

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[123] Meadows, 8.
[124] Kline, 439.
[125] Burton, 422-423.
[126] Kline, 378, 407.

reach the lowest point from any given point.[127] In the same paper, he challenged others to find the curve given by a cord or chain hanging between two fixed points (called a catenary). Independent solutions were published by Leibniz Huygens and Johann Bernoulli a year later.[128] Bernoulli published his work on the paths of quickest decent (brachistochrone curve) in the *Acta Eruditorum* in 1697.[129] His work on logarithm spirals in 1691 and a review of his major book, A*rs Conjectandi*, were published in both the *Acta Eruditorum* and the *Journal des Savants.*

Journals, which got their start with the societies of the 17th century, were here to stay. Indeed, during the last 50 years, almost all new results in mathematics have appeared in journals first. Books are usually written to encompass decades of work and designed to teach others about the subject matter, not to introduce groundbreaking research. Thus the legacy of these societies and journals continue to live on, and the rate of progress in science and mathematics is consequently much more rapid than it would have been otherwise.

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[127] Weisstein, Eric W. "Tautochrone Problem." From MathWorld--A Wolfram Web Resource. http://mathworld.wolfram.com/TautochroneProblem.html (5 February 2010).

[128] Kline, 471-472.

[129] Boyer, 417-418.

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Vita

Eric Savage was born in Statesville, NC. He attended West Iredell High School in Statesville, NC where he first became interested in mathematics through his Advanced Placement Calculus teacher. After graduation, he went to Banner Elk, NC to attend Lees-McRae College where he obtained a Bachelors of Science degree with a major in Mathematics and a minor in History. He accepted a graduate teaching assistantship at the University of Tennessee in Knoxville, TN where he earned a Masters of Science with a major in Mathematics and a minor in Statistics.