The Maclaurin Buildings:
A History of MIT's Main Campus and the People Who Built It

by

David C. Christoff

Submitted to the
Department of Mechanical Engineering
In Partial Fulfillment of the Requirements for the Degree of

Bachelor of Science in Engineering
as Recommended by the Department of Mechanical Engineering

at the

Massachusetts Institute of Technology

June 2014

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ABSTRACT

In 1916, the Massachusetts Institute of Technology relocated from its Boston Tech campus to its newly built facilities in Cambridge. During the construction of the New Technology in the May of 1915, MIT president Richard Maclaurin decided to have the names of famous scientists, engineers, inventors, and philosophers engraved on ten faces of the square pavilions that capped each of the buildings. In the end, 115 names were chosen, and they remain on the MIT buildings to this day.

This thesis explores how Maclaurin came to choose the men whose names now adorn the MIT rooftops. It also explains who each of these individuals was and how they came to so greatly influence their respective fields.

Thesis Supervisor: Gareth McKinley
Title: Associate Head, Department of Mechanical Engineering

Acknowledgements

As the author, I must thank several people, without whom this project would not have been possible. I owe a debt of gratitude to the MIT Libraries staff, especially Angie Locknar and Michelle Baildon, for their assistance and direction as I began my research. Similarly, I must thank the efforts of the MIT Archives staff for the readiness and expediency with which they directed me to resources, as well as Debbie Douglas and Peter Shulman '01, whose advice regarding the overall nature of the project alerted me to aspects that would have otherwise gone unnoticed. Finally, I must thank my supervisor, Professor Gareth McKinley, for not only imagining the original concept for this thesis, but also for facilitating my research with his unique insights into the subject matter.

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1. Introduction

The brisk December air nipped at Dudley Fay's ears as he meandered down the bank of the Charles River. The winter of 1915 hadn't been a terrible one, but this particular Sunday was proving the exception. Perhaps, he thought to himself, he should have heeded his wife's advice to bundle up, but he had made it his mission to venture into Cambridge from his home in Boston.

Dudley adjusted the scarf that Katharine had attacked him with on his way out the door. If he was to be honest with himself, he wasn't exactly pleased he had to make the trip in the first place. The move from Cambridge to Boston a year earlier hadn't been easy for his young family, and when the 24-year-old Harvard transfer originally heard that his new home at Boston Tech was planning to move back into Cambridge, he was less than enthused. Nonetheless, Dudley had made a monthly habit of examining the construction of Tech's new campus, if only just to make the prospect of yet again moving his wife and two children easier to swallow. Dudley nodded quietly to himself as he finally came between the Charles and the newly erected Great Dome. The progress since November was astounding. His gaze was drawn immediately to the letters that had appeared underneath the dome's circular silhouette: MASSACHVSETTS INSTITVT OF TECHNOLOGY. Dudley chuckled to himself—it would be difficult telling his wife he was transferring for a second time.

With most of the main structures completed, the rumors that the buildings would be finished by the next summer in 1916 seemed justified. Dudley's eye traced around the fresh limestone rooftops to the current construction, where scaffolding on one of the western buildings supported stonemasons who appeared to be engraving the frieze of one of the structure's square rooftop pavilions. Dudley couldn't quite make out what they were writing, but an inspection of the adjacent pavilion yielded his answer: each of the rectangular faces bore the names of famous scientists, mathematicians, engineers, and philosophers.

He paused in front of a wall capped by Aristotle's name. Below him, in smaller type, were more of the greats: Thales and Pythagoras and Euclid and—oh no. Dudley squinted as he saw what appeared to be a typographical error engraved in foot-high letters facing the Charles. The Greek philosopher, Apollonius of Perga, had been corrupted to "Appolonius" in the limestone. Thinking himself mistaken, Dudley hastened back to Boston, where he scoured the

encyclopedias in Tech's libraries for the character spelled Appolonius, but to no avail. Astounded, he wrote to the company in charge of the construction regarding the discrepancy[1]. His letter, now housed in the MIT Institute Archives, is the only remaining record of the mistake having occurred, but little did Dudley know that the error originally began with someone much higher up the chain of command.

Photograph of the new buildings circulated in *The Tech* ca. 1935

The New Technology, as it was called during its inception, was the brainchild of Richard Maclaurin, MIT's president from 1909 to 1920. With space in the original Boston Tech campus on Boyston Street becoming cramped, Maclaurin made the decision to build new facilities in Cambridge. The project included what is now the main campus around Killian Court (then it was known merely as "The Great Court"), Walker Memorial, and the house of the president.

As construction was about to begin on the new buildings, Maclaurin received a letter from an alumnus with a suggestion that they should be inscribed with some sort of message, as the alumnus put it, "similar to the engraving on the door to Plato's academy, 'Let no one ignorant of geometry enter.'" Maclaurin immediately took to the idea, but he decided to alter it slightly: he would engrave on the buildings the names of famous scientists, engineers, and inventors.

The practice itself was not unheard of. The frieze of the Rogers Building on the original Boston Tech campus was similarly dedicated, as well as four sides on the first stage of the recently constructed Eiffel Tower and the face of the new engineering building at the University of Wisconsin (whom Maclaurin would later consult[2]). The implementation of Maclaurin's plan, however, would prove a tremendous undertaking. It was determined that one hundred scientists would be featured on the ten available faces of the pavilions on the new buildings, with one prominent name in large type and nine others below him. It is perhaps a credit to Maclaurin's fastidiousness that the list only ballooned to 115 names in the weeks that followed.

Maclaurin began assembling his great list by contacting each of his eleven Department Heads to request the names of scientists who had been influential in their respective fields[3]. The Department Heads then consulted with their colleagues and returned lists to Maclaurin, some as short as three names and some well over one hundred. Though Maclaurin made it clear that no living scientist should be considered, many of the lists included the likes of Thomas Edison and Alexander Graham Bell, whose accomplishments were already thought by many to be timeless[4].

After assembling all of the names into a master list, Maclaurin sought the help of two of his colleagues to trim the fat: an MIT board member named F.P. Fish and Electrical Engineering Department Head Elihu Thompson, who would later succeed Maclaurin as president of MIT.

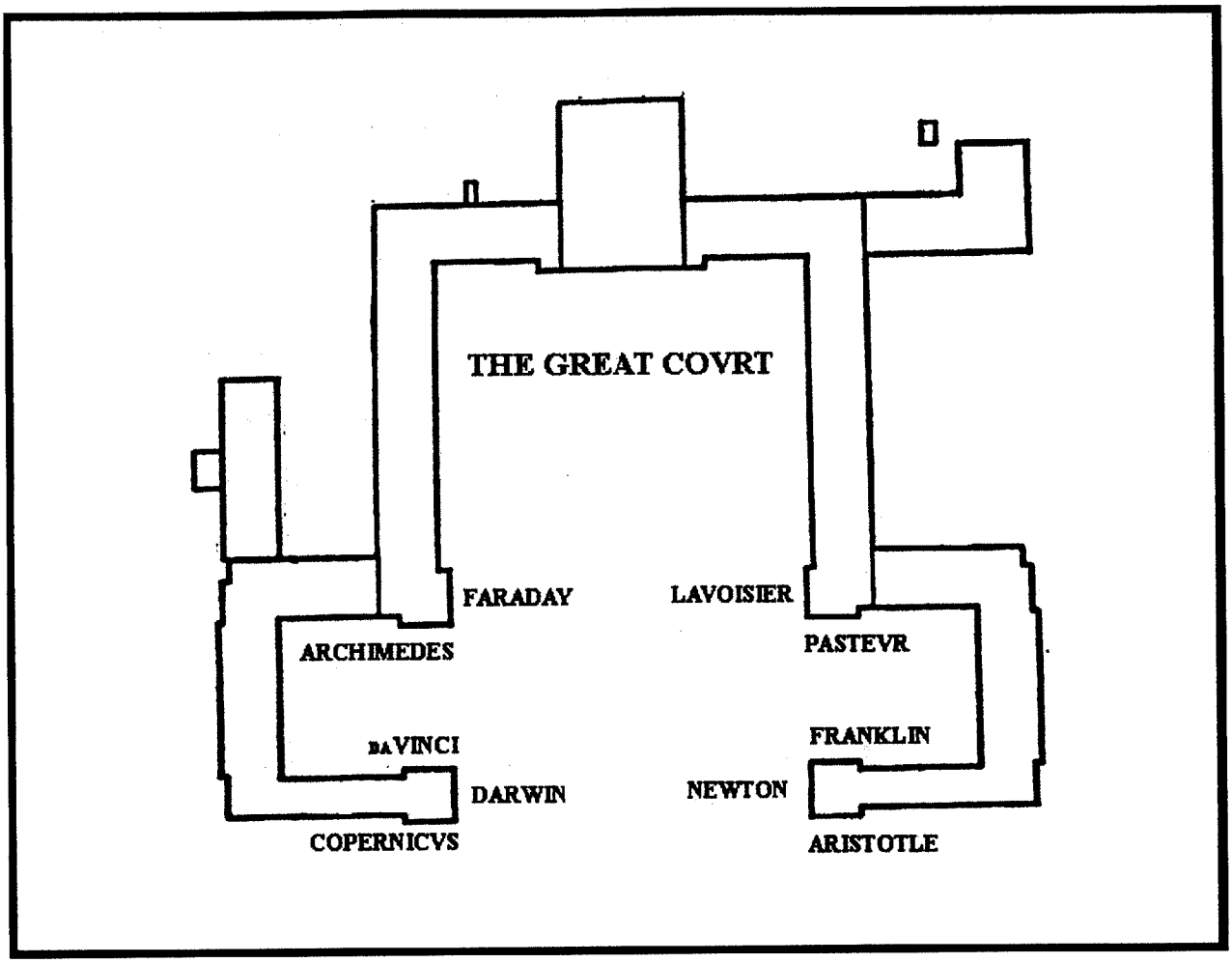
After about two weeks of intense deliberation, the three met over lunch in late May of 1915 to develop a final list to present to the MIT Corporation on the 29th that month[5].

Though there were many internal disputes about the merits of the various men submitted for consideration (there was, at the time, significant opposition to the inclusion of many famous architects[6]), the most debated name was easily that of William Shakespeare. Maclaurin had originally proposed Shakespeare as one of the ten featured names on the pavilions, citing him as, "showing pre-eminently an insight into humanity in its limitless phases[7]." Neither Fish nor Thompson voiced opposition to the idea, but the name was eventually dropped entirely, most likely during the Corporation meeting that May. Maclaurin also desired to have an American among the featured ten, and it can be no coincidence that Benjamin Franklin was promoted in Shakespeare's stead.

So committed to Shakespeare was Maclaurin that he took significant effort to ensure the correct spelling of his name. Under the suggestion of Fish, he commissioned the help of Professor George Kitredge at Harvard to explain the various spellings[8] (both 'Shakespeare' and 'Shakespear' were used at the time). Ironically, it appears that it was Maclaurin who introduced the only meaningful spelling error into the equation when he falsely transcribed the name of Apollonius in a letter to Thompson[3].

The construction company, Stone & Webster, must have been shocked when they received Dudley Fay's letter regarding the error in December of 1915. President Maclaurin had chosen the company in part because its founders, Charles Stone and Edwin Webster, were both MIT alumni, ensuring that proper care would be taken in the construction of the new buildings. Dudley's letter was quickly forwarded to Maclaurin, and the limestone with the error was replaced.

As a student, alumnus, or faculty member looks on the names that adorn the pavilions today as Dudley Fay had almost one hundred years ago, they will surely recognize the names of men who had a direct influence on their education. Others, they might not know so well, and even other names they may never have seen before. Who were these men? Why are they, in particular, honored on the faces of the Maclaurin buildings?


THE GREAT COVRT
FARADAY
LAVOISIER
ARCHIMEDES
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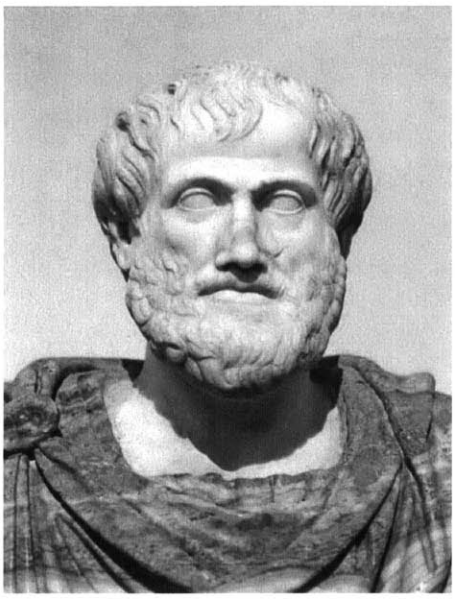
Building 2, Northern Face
Geometers and Natural Scientists



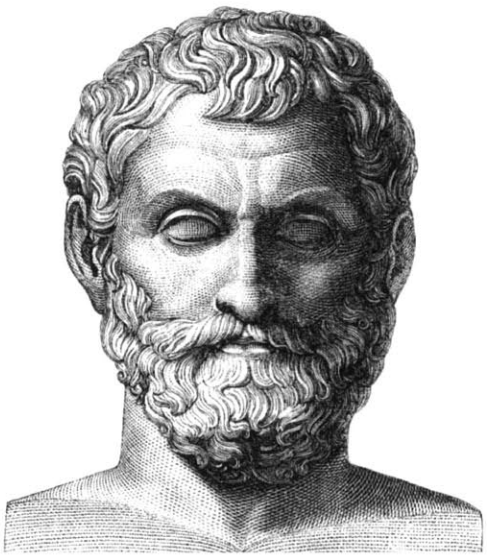
2.1 - Aristotle

Aristotle (384 – 322 BC) was a Greek philosopher well known for his contributions to the human understanding of ethics and politics and his deep reaching assertions in physical science, his work in a broad range of fields had a profound influence on both ancient and modern worldviews.

Born in northern Greece, Aristotle grew up learning from his father, the personal physician of Amyntas II of Macedon, who was the grandfather of Alexander the Great. At the age of 17, Aristotle moved to Athens to join Plato's Academy, where he would stay for twenty years. He left Athens upon Plato's death, traveling for a few years before returning to Macedon to tutor prince Alexander. When Athens subsequently came under Macedonian rule, Aristotle once again returned, only to be exiled after Alexander's death in 323. He would die a year later.

Unfortunately, most of Aristotle's work intended for the public has been lost through the years, and modern scholars have been left with what were essentially his "lecture notes," intended only for internal use within Plato's Academy[9]. According to the Greek historian Strabo, a succession of last rights dating to the will of Aristotle himself landed the philosopher's manuscripts in the hands of Neleus of Screpsis, in whose cellar they were lost until the first century BC. A few short years after the manuscripts were rescued, Athens was seized by Cornelius Sulla, and Aristotle's work was brought to Rome, where it was copied into the surviving texts we have today.

In early iterations of MacLaurin's list, Aristotle was not one of the ten featured names, but after consultation with F.P. Fish (1915)[4], he was elevated to the top of the list, where he remained throughout consideration



2.2 - Thales

Considered by many to be the founder of natural philosophy (at least in ancient Greece), Thales (625-547 BC) is quoted by Plato, Aristotle, and others as a forbearer of astronomy, geometry, and engineering.

There is much controversy about the life of Thales, and his works and contributions to human knowledge were debated even in antiquity. He has no surviving published works (there is some doubt as to whether he published anything in the first place[10]), and most accounts of his life either contain discrepancies or are purely anecdotal. Nonetheless, Thales has generally been credited with being among the first of the ancient Greeks to seek natural explanations for physical phenomena, develop theoretical mathematics, and study the cosmos. Some accounts describe him importing mathematics to Greece from Egypt and proving, among other things, that a circle is bisected by its diameter. His most famous supposed feat was the prediction of a solar eclipse, though modern scientific historians doubt his ability to actually do so[11].

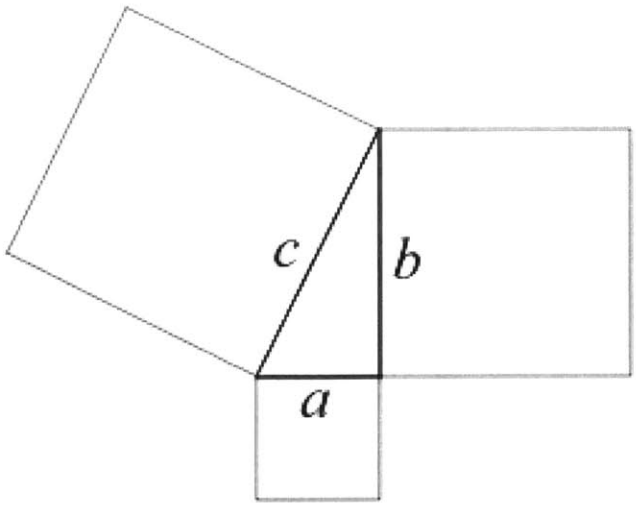
According to many accounts, Thales was considered a man of significant practical knowledge who sought to apply his natural philosophy whenever possible. During his life, he gained notoriety as a statesman and a businessman alike, and it appears his reputation as a brilliant mind aided him in accomplishing business transactions. According to an account by Aristotle[9], Thales once used his influence to "predict" an olive surplus, which he then used to corner the market and turn a large profit. Ancient insider trading aside, Thales's reputation for brilliance likely caused him to receive more credit than he was due and may explain his so-called prediction of the solar eclipse, the "discovery" of Ursa Minor, and a number of other dubious attributions[10].

2.3 - Pythagoras

Pythagoras (560-480 BC) was a Greek geometer most famous for his theorem of right triangles. He is also known for his work with musical harmony and was among the first to broadly conceptualize a model of Earth that was in constant motion through space.

Born on the Greek island of Samos, Pythagoras gained most of his knowledge in Egypt and Babylonia in his earlier years before forming his own religious sect and school of philosophy in Croton (southern Italy). During his travels abroad, he began to develop the concept that everything in the world was related to numbers and ratios. It is possible that he picked up his famous and eponymous theorem in Babylon (there is evidence it was known there while he was alive[12]), but history has obscured the truth. His study of mathematical ratios and musical harmony carried over into the other aspects of his philosophy, in which, for example, the pursuit of "a number for justice" was considered a legitimate concept. The religious sect Pythagoras founded in Croton would serve as a model for later schools of philosophy, and had long-reaching influence on Plato and other ancient minds.

Unfortunately, due to political tension over the rise of democracy in Croton, most contemporary accounts of Aristotle have been lost. Exacerbating the problem was the split in his disciples due to political violence. According to Herodotus, Pythagoras only shared his teachings with his most advanced followers, opting to communicate with his lower-level disciples in short, cryptic phrases. When the more plebeian Pythagoreans split from the sect, they would come to take these phrases at face value, and eventually two entirely separate schools of thought would lay claim to Pythagorean origins.

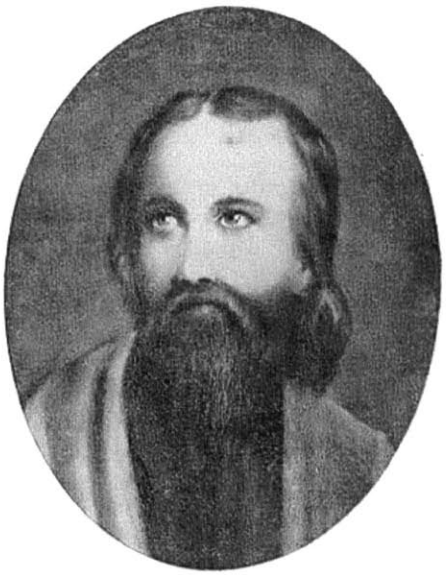


A geometric visualization of Pythagorean Theorem

2.4 - Euclid

Known by many as "the Father of Geometry," Euclid spent his life in Alexandria around the turn of the fourth century BC. His best known publication, the *Elements,* helped to develop the concept of rigorous mathematical proof.

For all of his fame in the field of geometry, almost nothing is known about Euclid's life. He is said to have founded the great school of mathematics in Alexandria and is referenced in the work of Archimedes, which is how most scholars are able to place him chronologically in the first place. Due to this lack of knowledge (even relative to others from the same time period[13]), some theories have surfaced that Euclid is a pseudonym for a collaboration of mathematicians, but this line of thought, along with a fictitious biography written by Arabian authors, is almost universally disregarded. What few accounts remain of Euclid describe a mild-mannered individual who took his craft seriously. Anecdotal evidence, however spurious, suggests his passion for mathematics for mathematics' sake, and the historian Pappus described him as, "most fair and well disposed toward all who were able in any measure to advance mathematics, careful in no way to give offense, and although an exact scholar not vaunting himself."



APOLLONIUS—THE NAZARENE.

2.5 - Apollonius

Though the exact dates of his birth and death are unknown, scholars can place Apollonius of Perga (now a city in Turkey) during the late third century BC. He is known for his work in geometry and mathematical developments in conic sections.

Relatively little is known about the life of Apollonius, and only two of his original texts have survived through the ages. He was most famous for his research with conic sections, his book about which became the primary authority on the matter at the time. Unfortunately, because the use of Apollonius's books became so widespread in the ancient world, it is difficult to modern scholars to determine how much of his work is original, as most other comparative resources on the subject were not preserved[14]. Essentially, Apollonius's work with conic sections was so pervasive that we cannot tell how groundbreaking it actually was.

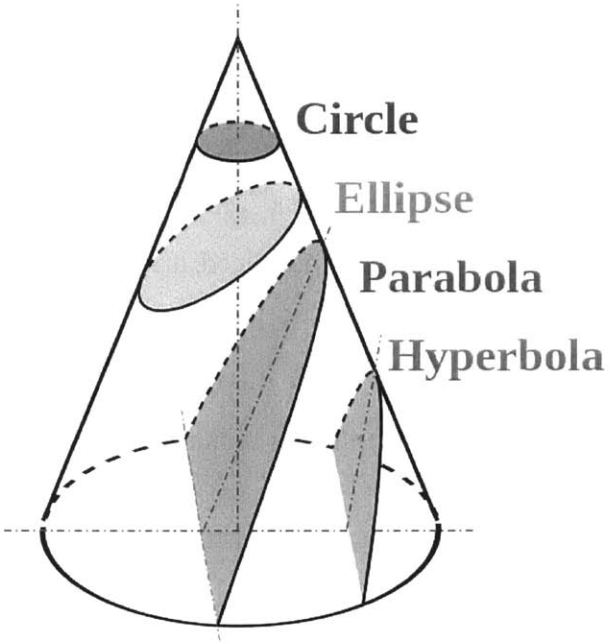


Illustration of various conic sections, taken by the intersection of a plane and a right cone

2.6 - Hipparchus

Hipparchus (second century BC) was a Greek geometer who possessed the first known trigonometric table, which he used to help him predict celestial movements. He was most famous for discovering the precession of the equinoxes due to slow changes in the orientation of the Earth's axis.

Though his birth year is unknown, scholars believe Hipparchus to have spent most of his life in Nicaea (now Turkey), with potentially a short stint in Alexandria prior to his death in 127 BC. He has only one surviving publication, but most of our knowledge of his life and work come from ancient histories and references in Ptolemy's *Almagest*, which leans significantly on Hipparchus's research. He is considered by many to be one of the greatest ancient astronomers due to his accurate star maps and models of the sun and moon. The only hindrance to the accuracy of his models was the ubiquitous ancient assumption of perfectly circular orbits, the discrepancies brought about by which would be used to support a geocentric model of the universe until the Renaissance[15].

Like many ancient scholars, Hipparchus benefited from his status as one of the few famous minds during his lifetime. In the past, he has been credited with the invention of the astrolabe, though the evidence for such is specious[16]. Like many ancient thinkers, he most likely received credit for more work than he actually produced, and when the decision was made to include his name on MIT's new buildings in 1915, he was generally considered to be Ptolemy's only source in his writing of *The Almagest*. While modern evidence suggests that this is almost certainly not the case[15], Hipparchus's contributions to humanity's understanding of astronomy cannot be overlooked.

2.7 - Ptolemy

Ptolemy (90-168 AD) was a Greco-Roman astronomer, mathematician, and geographer who lived in Egypt during the second century AD. He is best known for the *Almagest,* which served as the primary text on astronomy throughout the middle ages. His *Geography* also mapped the entire known world.

Though much of his work survives, relatively little is known about Ptolemy's life. He was born in 90 AD and lived to the age of 78, producing work in the natural sciences in Alexandria. His famed *Almagest* detailed star charts, equinoctial predictions, and theories of motion for the sun, moon, and known planets. Although incorrect in its geocentric model (an issue that would continue for over a millennium to come), the *Almagest* is even now praised for its manner of beginning with only basic assumptions of algebra and elaborating to the details of celestial motion[17].

Ptolemy's other famous work, the *Geography*, mapped the entire world as it was known during the time, overlaying a grid system remarkably similar to today's latitude and longitude, with the prime meridian crossing the Canary Islands, the westernmost known point. Latitudes were marked from the equator, based on the number of hours of daylight on the summer solstice. Though many of the facts in the *Geography* are incorrect (maps tended to get less accurate as the distance from Rome increased), the book successfully outlined methods of cartography to preserve accuracy in translations and copies of the text, and it survived remarkably well for it.

2.8 - Fourier

Jean Baptiste Joseph Fourier (1768-1830) was a French mathematician and physicist who developed models for heat conduction. He is most famous for his idea to represent complicated and discontinuous functions as the sum of infinite series, a concept now known as a Fourier Series.

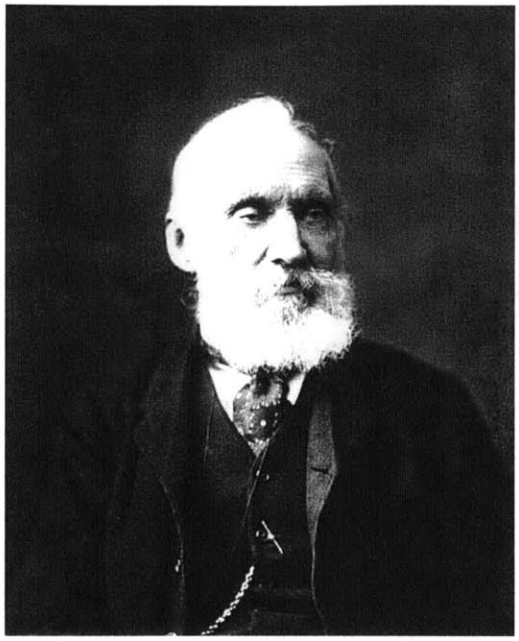
After the death of his parents when he was nine, Fourier came of age in the local military school in his home of Auxerre as France was on the verge of revolution. His fate became intertwined with that of his country, and Fourier's twenties found him in a variety of circumstances due to the unstable political climate. In a style befitting the nature of the French revolution, Fourier was jailed twice during the 1790's. On the first occasion, he was detained during the Reign of Terror for political action against Maximilien Robespierre, who denied Fourier's appeal. He was released after a short period, but three years later, Fourier was again arrested, this time found as a supporter of Robespierre in the eyes of the new regime. His fellow lecturers at the école Polytechnique were able to negotiate his release, sending him to join Napoleon's Egyptian campaign in 1798[18]. While serving as a diplomat and military engineer in Egypt, Fourier developed an interest in heat transfer, and he undertook the associated physics as a course of study when he returned to Paris[19]. In addition to his contributions to the study of dimensional analysis, he produced the partial differential equation model for heat conduction still used today, and, while his first attempt at what would later be called a "Fourier series" was too vague to constitute a rigorous proof, he was renowned for introducing the concept to the mathematical world.

2.9 - Helmholtz

Hermann von Helmholtz (1821-1894) was a German scientist who studied and contributed to a wide range of fields including physiology, thermodynamics, optics, acoustics, and electromagnetism. He also significantly shaped the modern understanding of physics in the 20th century, and was one of the last major scholars to significantly diversify himself in the different varieties of physical science and philosophy.

Helmholtz's scientific career was very much that of a journeyman. Born in Potsdam in 1821, he developed an interest in physics at an early age. Since his family wasn't wealthy enough to put him through higher education, Helmholtz's father instead convinced him to pursue the state-financed study of physiology. He spent 13 years in the study and military practice of medicine, while supplementing his learning with lucubrations in the work of Laplace, Biot, Bernoulli, and Kant. Between 1849 and 1868, Helmholtz held various positions in physiology at multiple universities.

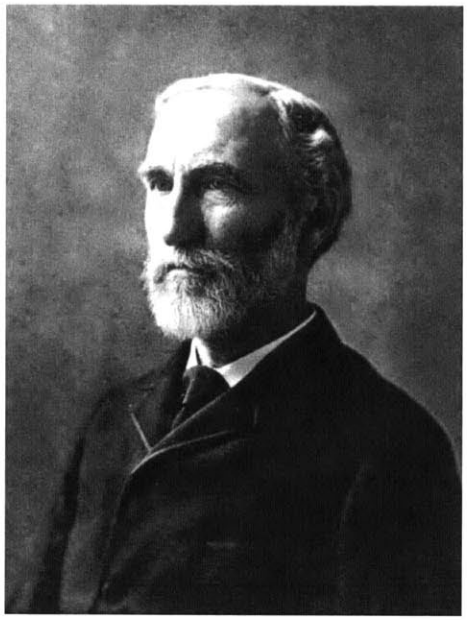
By 1866, Helmholtz began to tire with his work in physiology, eventually bemoaning the fact that a single individual could no longer understand the full breadth of the subject due to its complexity[20]. He thus switched his focus to areas such as thermodynamics and electromagnetism, becoming the Chair of Physics at Berlin in 1871. From there, he would continue his significant contributions to the scientific world until his death in 1984.



2.10 - Kelvin

Sir William Thompson (1824-1907), known as Lord Kelvin, was a British physicist and engineer known for his work in thermodynamics, instrumentation engineering, and telegraph development. He is best recognized for the temperature scale bears his name as a result of his most notable discovery: the determination of the value for absolute zero temperature. He is referred to by some as the "Founder of British Physics"[21].

Born in Belfast, Thompson was the son of a mathematics professor. When he was ten, his father was hired to a professorship at the University of Glasgow, where the young Thompson was able to benefit from the learning opportunities the university often offered adolescents. He attended Cambridge University from 1841 to 1845, after which he moved to Paris to work in the laboratory of Henri Regnault at the suggestion of his father. His time there proved critical to his development as a scientist, and he quickly found himself a professor of natural philosophy at Glasgow in 1845. There, he founded Britain's first teaching laboratory in the model of Regnault, recruiting James Joule to develop his instrumentation. With his help, Kelvin devised his famous absolute temperature scale in 1848[22].



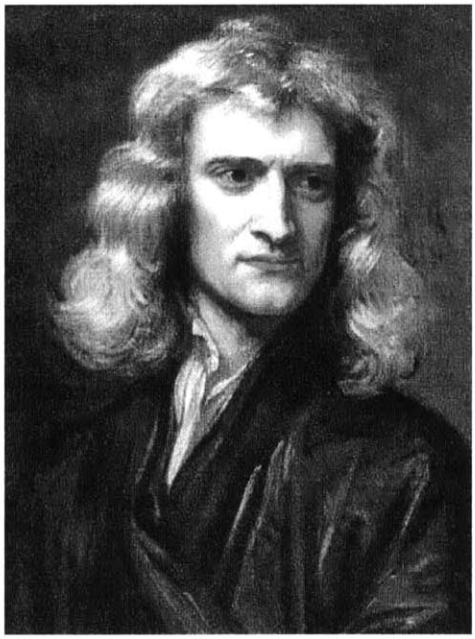
2.11 - Gibbs

Josiah Willard Gibbs (1839-1903) was an American physicist and mathematician. At Yale, he applied Maxwell's equations to physical optics, created statistical mechanics to explain the laws of thermodynamics[23], and co-invented modern vector calculus, popularizing the "del" notation commonly used today. He may be best known for establishing the scientific principles of the Gibbs Phenomenon and Gibbs Free Energy.

Gibbs was a man fond of routine and familiar surroundings. Humble and patient, he was born in New Haven, Connecticut, where he would mature, live, and work for all but three years of his life. After spending time in Paris, Berlin, and Heidelberg upon his graduation, he returned to a professorship at Yale, the first nine years of which he would perform unpaid. Gibbs seemed content to live off his inheritance until he received an offer from the Johns Hopkins University in 1880, which he entertained until Yale countered with an offer of two-thirds the salary. Until his death in 1903, Gibbs lived in the house in which he grew up, rarely leaving New Haven only for the occasional conference or vacation, all the while producing work that would inspire Albert Einstein to call him, "the greatest mind in American history"[24].

Despite his success, Gibbs sought no praise. His obituary claimed he was "devoid of personal ambition of the baser sort or of the slightest desire to exalt himself, he went far toward realizing the ideal of the unselfish, Christian gentleman"[23]. Indeed, Gibbs published his fundamental work in thermodynamics in a little-known journal, *Transactions of the Connecticut Academy of Arts and Sciences,* which was edited by his sister's husband, and he doubted the innovative nature of his creation of statistical mechanics in a letter to Lord Rayleigh[24]. Despite his reserved nature, he achieved the acclaim of his colleagues in his scientific and mathematical innovations.

Building 2, Western Face
Mathematicians and Astronomers



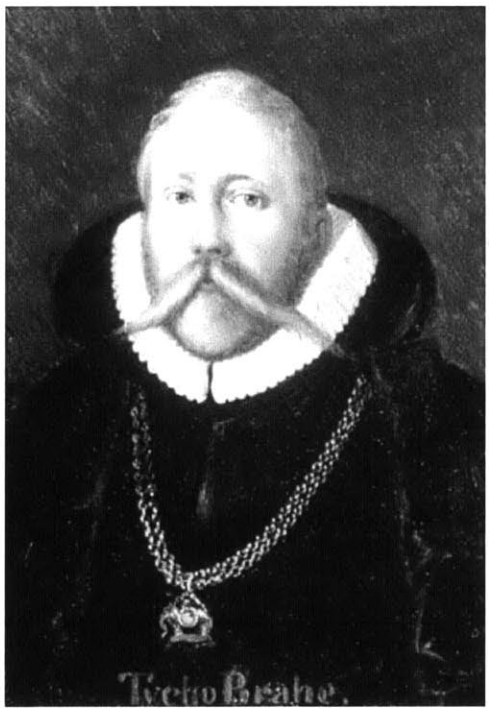
3.1 - Newton

Sir Isaac Newton (1642-1727) was an English physicist and mathematician generally considered to be one of the greatest and most influential minds in recorded human history. He established gravitational theory, co-invented infinitesimal calculus, and laid the foundations of classical mechanical physics. Among the least of his innovations in astronomy was the invention of the reflecting telescope, and his empirical law of cooling is still widely used today[25a].

Born on Christmas day in Lincolnshire, Newton never met his father, who had died three months earlier. Upon his mother's remarriage, he was left with his grandmother, who saw that he was educated in the classics until the age of seventeen. There is no doubt that Newton's lack of a father figure influenced his young life, and he confessed to fantasies of murdering his mother and stepfather in his youth[25b]. Upon the natural death of his stepfather in 1661, Newton was briefly removed from school to run the family farm, but his quick failure in agriculture prompted him to continue his education, eventually receiving a scholarship from Trinity College in 1664. When Trinity closed in 1665 as a precaution to prevent transmission of the bubonic plague[25c], Newton was forced to continue his studies at home. It was during this time that he famously burnt the candle at both ends in the beginning developments of calculus (dubbed "The Method of Fluxions" by Newton) and gravitation. With respect to the former, Newton became entangled in a dispute with Gottfried Leibniz due to their near-simultaneous invention of calculus, but most modern scholars credit each with developing the idea independently (even though Leibniz's notation was eventually adopted)[25b]. Eventually, Newton left his professorship, assuming the civil post of Warden of the Royal Mint in 1696.

Often fabled about Sir Isaac Newton is his epiphany of the theory of gravity when a falling apple struck him in the head. Though many have written this event off as a fairy tale, sources close to Newton actually corroborate the story, albeit in a bit more believable manner. John Conduitt, the husband of Newton's niece, wrote: "Whilst he was pensively meandering in a

garden it came into his thought that the power of gravity (which brought an apple from a tree to the ground) was not limited to a certain distance from Earth, but that this power must extend much further than was usually thought"[25c]. Of course, whether this actually occurred or Newton simply applied the analogy ex post facto will remain unknown.

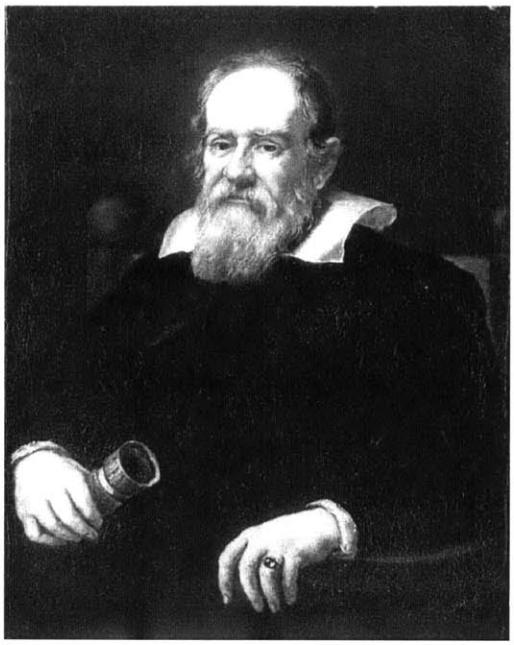


3.2 - Brahe

Tycho Brahe (1546-1601) was a Danish astronomer known for his diligent work in star mapping. His consistent observations of celestial movement ultimately allowed Johannes Kepler to arrive at his laws of planetary motion. He was also one of the last astronomers to work without a telescope[26].

Born in Skåne, Denmark (now Sweden), Brahe had ten siblings, including his own still–born twin. After witnessing the solar eclipse of 1560, Brahe became fascinated with celestial bodies and dedicated himself to carefully observing the heavens and improving instrumentation for astronomy. While his uncle and provider pushed him to study law, Tycho spent his nights secretly surveying the stars. In 1576, King Frederick II of Denmark offered him the island of Hven to carry out his observations, and Brahe would perform his best work there until his death. At Hven, he developed a hybrid geo-heliocentric model of the solar system, though many scholars believe Brahe secretly held a heliocentric belief, and the model was merely kowtowing to the church[27].

Despite a life filled with brilliant work, the circumstances of Brahe's death were somewhat foolish. After losing most of his nose in a sword duel in 1566, he began to wear a prosthetic that may have contained mercury that slowly poisoned him over the course of his life[26]. It is more likely, however, that Brahe's unremitting courtesy was his own undoing. According to Kepler's account, Brahe suffered an intestinal ailment after overindulging at a banquet in Prague. Kepler writes that Tycho refused to excuse his presence to relieve himself because to do so would be a breach of etiquette. Some accounts claim that Brahe even wrote his own epitaph: "He lived like a sage and died like a fool"[27].



3.3 - Galileo

Galileo Galilei (1564-1642) was an Italian physicist and astronomer widely recognized as one of the greatest scientists to ever live, and he served as a patriarch for Renaissance scientists in a variety of fields[28]. He has often been called "The father of modern science"[29].

Born in Pisa, Galileo's younger years were characterized by constant upheaval. As a boy, he received private tutoring at home before his father sent him to the well-known monastery of Santa Maria at Vallombrosa. When Galileo tried to join the order in 1578, his father sent him to Florence. Undiscouraged, the ever-persistent teenager once again began to associate with Vallombrosan monks, but, after three years, he was eventually convinced to study medicine at the University of Pisa. While there, Galileo developed an interest in mathematics and abandoned his course of study in favor of privately learning from the writings of Euclid and Archimedes. In 1598, Galileo was appointed chair of mathematics at Pisa, where he was quick to make enemies in the faculty due to his contrarian views on Aristotelian mechanics[28]. These nasty relationships drove him to the University of Padua three years later, where he would remain for almost two decades, over which he conducted most of his famous research. Growing Catholic opposition to those with heliocentric viewpoints forced Galileo to shy away from the public eye in 1915, and he would conduct his research in less controversial fields for most of his fifties. Eventually he was found guilty of heresy in 1633 by the Church, and he was convicted to house arrest until his death in 1642.

While Galileo's contributions to scientific knowledge are immeasurable, they have also built a significant legend around the man. In one fabled experiment to demonstrate the effect of acceleration due to gravity, it is said that Galileo dropped balls of different masses from the leaning tower of Pisa, so they might land at the same time[29]. While the story is believed to be false, similar tales of one of history's greatest scientists abound, only bolstering his reputation.

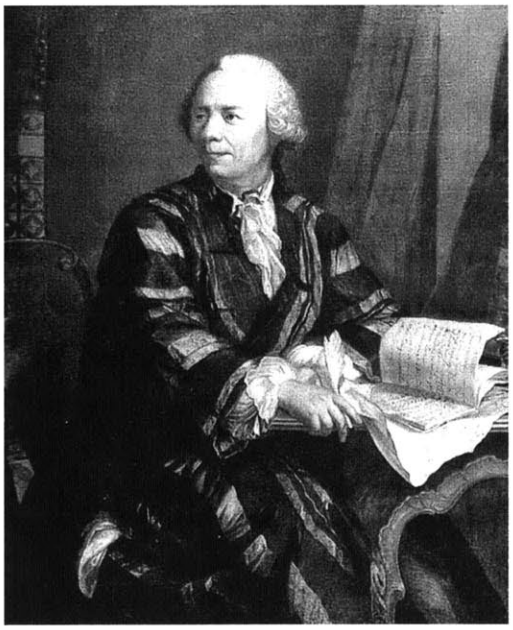
3.4 - Kepler

Johannes Kepler (1571-1630) was a German astronomer and mathematician famous for his three laws of planetary motion, which improved on the accuracy of the extant heliocentric models (still in doubt at the time) by a factor of over one hundred[30]. His work brought together the fields of physics and astronomy in a way that had not previously been done in antiquity.

The son of a mercenary, Kepler was born in Weil der Stadt, Germany, during the December of 1571. He matriculated to the University of Tübingen in 1589, during which time he studied both geocentric and heliocentric models of planetary motion. Upon his graduation, Kepler, then intending to become a clergyman, was called upon to fill a vacancy as a mathematics teacher at the Lutheran school in Graz. While there, he was able to describe planetary orbits with a series of concentric nested polyhedrons and develop a formula for each planet's orbital period. Kepler published his findings in the *Mysterium Cosmographicum (Cosmic Mystery)*, the first major text to support a heliocentric view since the writings of Copernicus[31]. In 1600, Kepler began to work with Tycho Brahe, during which time he developed his famous three laws of planetary motion and became the first known astronomer to propose and observe elliptical planetary orbits[30]. By 1621, he had published his most famous work, *Epitome astronomiae Copernicanae* (*Epitome of Copernican Astronomy*), which contained his laws of planetary motion and attempted to use physics to describe celestial movement, including the notion that the sun's effect on planets decreased with distance (though gravity at this point was still an undefined concept). His last publication, the *Rudolphine Tables,* was printed in 1628 and was a continuation of star data originally taken by Brahe. Kepler died in 1630.

Throughout his life, Kepler's faith both drove and threatened his work. As a Lutheran, he was less afraid than some of his peers to embrace a heliocentric model of the solar system. In fact, his understanding of the universe reinforced his thinking, as he saw the sun, stars, and intermittent space as a divine image of the Holy Trinity[31]. By the same token, Kepler was

constantly on the move after the turn of the century due to religious tension. On one occasion, his mother was even accused of witchcraft[32]. For all of the order assumed by his planetary models, the political unrest of the Thirty Years War ensured the latter half of Kepler's life was spent in chaos.



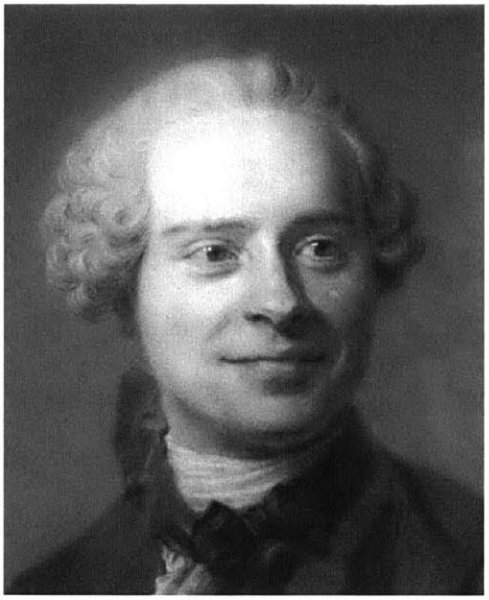
3.5 - Euler

Leonhard Euler (1707-1783) was a Swiss mathematician whose work covered a broad range of topics and still carries an incredible amount of relevance today. He published a litany of texts and is widely considered one of the greatest mathematicians of all time. He may be best known for Euler's number in calculus.

Born in Switzerland in 1707, Euler received his Master of Philosophy at the age of sixteen from the University of Basel. In 1727 he was promoted to the mathematics department at the Imperial Russian Academy of Sciences in St. Petersburg, from which it would take four short years to become the department head (he was 24 at the time). Political turmoil sent Euler to the Berlin Academy in 1741, where he would stay for 25 years, eventually returning to St. Petersburg when the climate bettered[33].

Euler's contributions to mathematics are nearly immeasurable, but his influence is most apparent through his various notations (most notably those in trigonometry and summation) which are still used today. He introduced the concept of a function, the use of 'i' to signify imaginary numbers, and he even popularized the use of pi notation in geometry[34]. Some of his most influential findings include his work in power series and the development of his famous formula: $e^{i\pi}+1 = 0$, though his work still has a significant impact on physics, astronomy, and engineering applications today.

Almost more impressive than his contributions to mathematics were the conditions under which Euler made them. His eyesight worsened significantly over the course of his career, and he was so sightless in his right eye during his time in Germany that King Frederick took to calling him "Cyclops." Euler would be completely blind by 1766, but he was able to rely on his impeccable memory for his research. Among other things, he was able to recite the entirety of Vergil's Aeneid, a skill which would allow him to continue his work[35].

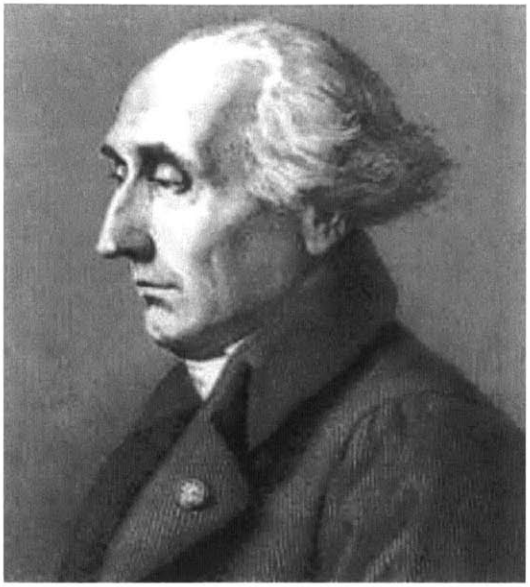


3.6 - d'Alembert

Jean le Rond d'Alembert (1717-1783), was a French mathematician and physicist. He served as a mentor to Pierre-Simon Laplace and is most famous for his solutions to the wave equation in physics.

Just days after his illegitimate birth, d'Alembert was found on the steps of the Saint-Jean-le-Rond de Paris church. He was later adopted from the local orphanage by working-class couple with whom he would live until he was forty-seven years old[36]. His father remained unknown to him but paid for his son's private education, and d'Alembert grew up a well-rounded scholar in fields ranging from mathematics to the classics. Between 1739 and 1757, he published works ranging in such diverse topics as fluid mechanics and philosophy. With respect to the former, he is famous for his paradox involving drag on a body in a moving fluid, which would go unsolved for over a century and a half. Some of his greatest achievements, however, came in the field of mathematics, in which, among other things, he developed the ratio test for a convergent series.

While his positive scientific contributions have proved significant, d'Alembert is also very well known for his shortcomings in the field of probability theory. He famously made the incorrect assumption that a coin has an increased chance of landing on heads for every time it lands tails, and he has been associated with the mis-attribution of dependency in probability ever since. Unfortunately for the mathematician, gambling strategies that invoke such logic are commonly referred to as "d'Alembert systems"[37].



3.7 - Lagrange

Joseph-Louis Lagrange (1736-1813) was an Italian mathematician and astronomer whose contributions to analytical mathematics and celestial mechanics built on the work of Sir Isaac of Newton and served to lead the field into the 19th century. He is best known for his brand of classical mechanics based on the principle of least action.

Born in Turin, Lagrange spent the first seventeen years of his life preparing for a career in law, according to the wishes of his father, until a chance encounter with a paper by Edmund Halley sparked an interest in mathematics. Within a year, Lagrange was an assistant professor at the Royal Military Academy of the Theory and Practice of Artillery in Turin. At this young age, he was already corresponding with Leonhard Euler on the development of the calculus of variation (including the Euler-Lagrange equation) which he would later publish[38]. There was significant pressure from other prominent mathematicians, including Jean le Rond d'Alembert, during his twenties to take up a position at the University of Berlin, but Lagrange refused until Euler abdicated his role at the University and returned to St. Petersburg. Even then, it took a personal letter from King Frederick of Prussia himself to convince Lagrange to make the move[39]. A similar letter from Louis XVI brought him to Paris upon Frederick's death in 1786, though most of his major accomplishments had already taken place at this point. Lagrange would spend the rest of his life mired in the chaos of the French Revolution, spending much of his time summarizing and elaborating on his prior work[40]

Lagrange maintained significant relationships with many of his contemporaries, and it is clear that much of his work is influenced by other prominent mathematicians from his time. He was known to be close friends with d'Alembert, and he publicly mourned the deaths of scientists such as Lavoisier during the French Revolution. Perhaps most peculiar was his relationship with Euler, whom, despite collaborating on his most influential work, Lagrange never actually met face-to-face. He even avoided matriculating to the University of Berlin until Euler's departure,

claiming in a letter to d'Alembert, "It seems to me that Berlin would not be at all suitable for me while M. Euler is there"[38].

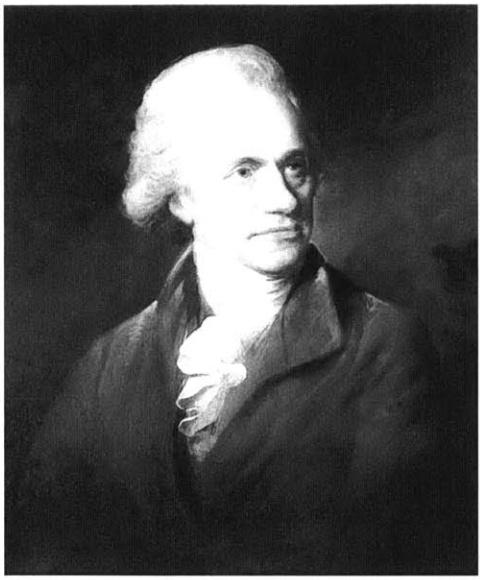
3.8 - Laplace

Pierre-Simon Laplace (1749-1827) was a French mathematician and astronomer whose work had a significant impact on a broad range of fields. He was one of the main developers of Bayesian probability and one of the first scientists to propose the existence of black holes. He is most famous for his contributions to mathematics, which include the Laplace transform and the Laplacian differential operator, which itself is used in Laplace's equation:

$\nabla^2\phi = 0$, where ϕ is a scalar function.

Born in Normandy, Laplace came from a middle-class family and showed a propensity for mathematics at an early age, and at nineteen, he was able to secure a letter of recommendation to Jean Le Rond d'Alembert in Paris. Skeptical of the young talent, d'Alembert is storied to have handed Laplace his biggest mathematics textbook, instructing him to read it for his first assignment. Laplace, according to legend, returned in just a few days having mastered the material, prompting a recommendation for a teaching position from d'Alembert[41]. Immediately setting to work, Laplace produced an enormous amount of research and quickly gained notoriety as a scientist. He was also heavily involved in the development of the metric system and served on the board that eventually determined the standard weights and measures[42].

Unfortunately, many of the more certain details of Laplace's life were lost when the family château caught fire in 1925, and his early years in particular are still debated[42]. Somewhat romanticized is the story of Laplace's humble beginnings, most likely a byproduct of his father's agrarian profession. Though many hold true that Lagrange was a self-taught mathematician from the French countryside, there is fairly significant evidence to suggest that he corresponded with Joseph-Louis Lagrange in Turin before matriculating to Paris in 1771[41].

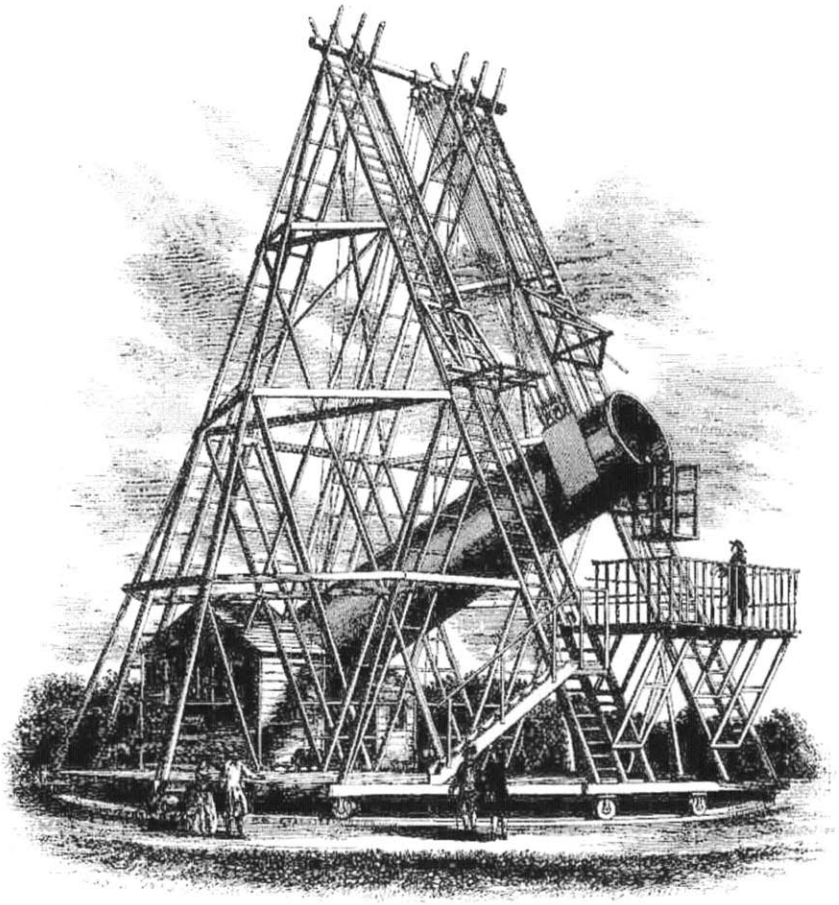


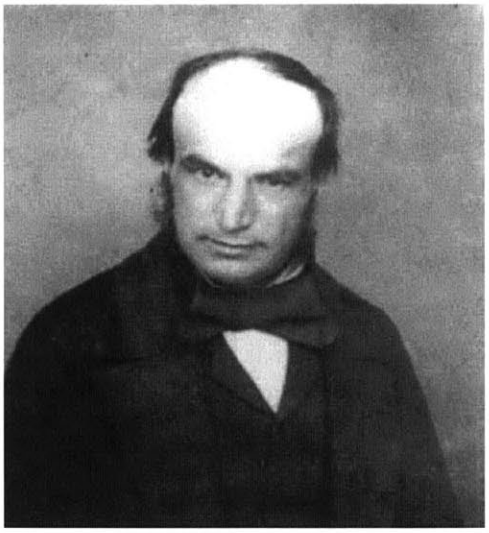
3.9 - Herschel

William Herschel (1738-1822) was a British astronomer famous for his discovery of Uranus, a number of moons, and infrared radiation. In addition to his astrological discoveries, he composed twenty-four symphonies and many other musical works.

Herschel was born in the Electorate of Hanover, where he conducted his learning in German. He followed in his father's footsteps by joining the Hanoverian Guard, whose allegiance to the British Crown was secured by George II. When he was nineteen, impending war with France forced Wilhelm Herschel to seek refuge in England, where he would adopt both the language and a new, anglicized rendition of his name. He spent most of his early years concentrating on music before developing an interest in telescopes and astronomy. Using his homemade telescope in his backyard, he cataloged the motion of the stars, leading to his proposal of binary star systems[43]. Herschel would go on to discover four moons between Uranus and Saturn after his discovery of Uranus itself.

As Herschel's searches into the night sky grew deeper, so did his need for more advanced equipment. While he was known to spend full days grinding and polishing his lenses and mirrors, often with the aid of his sister, Herschel's most impressive astronomical instrument was his massive 40-foot telescope, one of over 400 he created[44]:



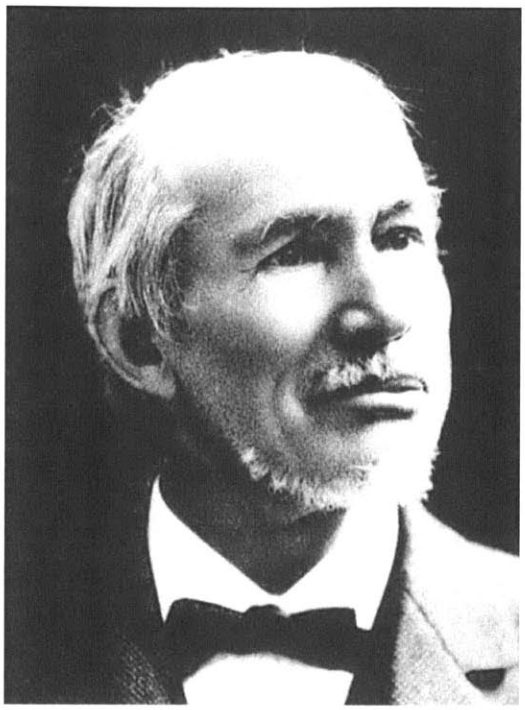


3.10 - Adams

John Couch Adams (1819-1892) was an English astronomer and mathematician famous for his purely mathematical prediction of the existence of Neptune.

Born on a farm outside of Launceston, Adams grew up with limited resources. As a young child, he harbored an interest in astronomy, going as far as to fashion his own instruments for measuring celestial motion[45]. In his teen years, he taught himself mathematics, and in 1839 he was granted admission to St. John's College at Cambridge University. Immediately upon his graduation, he set to the investigation of the problem that intrigued him the most: the irregularities in the orbit of Uranus. Two years after his graduation, Adams was able to predict the existence of an undiscovered celestial body disrupting the planet's orbit by approximating the solution to a ten-dimensional system of equations[45]. He went on to be elected president of the Royal Astronomical Society on his way to becoming chair of mathematics at the University of St. Andrews and later a professor of astronomy and geometry at Cambridge. Adams enjoyed the relative solitude brought by his professorship, and he held the position until his death in 1892.

As remarkable as his prediction of Neptune was, neither Adams himself nor his research were responsible for the planet's initial discovery. Upon publishing of his work, Adams, known for his reserved nature, failed to defend his findings from criticism. The door was then left open for the French astronomer, Urbain Jean Joseph Leverrier, to independently discover the same effect in the orbit of Uranus. After the existence of Neptune was confirmed, Leverrier was universally praised for his prediction, but, as is often the case, a controversy arose between parties in Britain and France about whose astronomer should be truly credited with the discovery. Today, the two share credit, but it should be noted that Leverrier's name does not appear on the face of any MIT buildings.



3.11 - Hill

George William Hill (1838-1914) was an American astronomer and mathematician best known for the "Hill sphere" used to calculate gravitational influence in celestial bodies.

Born in New York City, Hill moved to the countryside of New York when he was young. After his first astronomy publication, he was admitted to Rutgers College, where he studied under mathematician Theodore Strong and mastered the method of Eulerian approximation. After his graduation from Rutgers, Hill moved to Cambridge, Massachusetts to work on the *American Ephemeris and Nautical Almanac*, where he would stay for over two decades. During this time, he produced his most famous work, "Researches in Lunar Theory," which described the three-body problem celestial mechanics. Over the course of his career, Hill gradually gained international acclaim in astronomy circles, though he retreated to upstate New York in the latter half of his life, where he lived in recluse. Nonetheless, his contemporary Simon Newcomb described Hill as, "the greatest master of mathematical astronomy during the last quarter of the nineteenth century"[46].

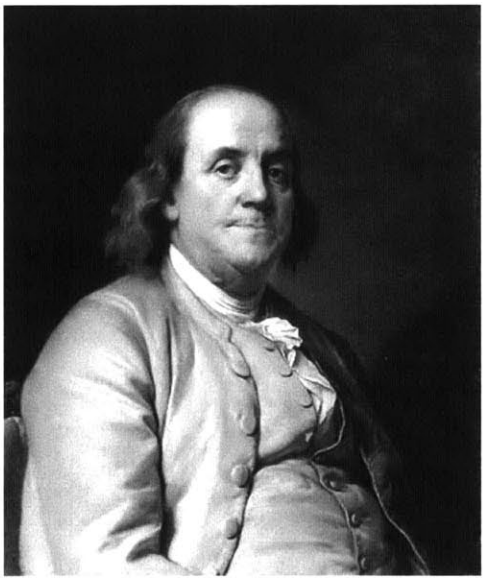
3.12 - Poincaré

Jules Henri Poincaré (1854-1912) was a French mathematician and physicist. His broad-ranging contributions to both fields covered topics from chaotic deterministic systems to celestial mechanics to topology. The Poincaré conjecture, proposed in 1904, is one of the most famous in mathematics and was not solved until 2002.

From the moment he began his schooling in his home town of Nancy, Poincaré excelled in almost every subject. His brilliance made fit his graduation from the École Polytechnique in 1875, an event which may have occurred sooner if Poincaré had not interrupted his studies to join the Ambulance Corps during the Franco-Prussian War. He then proceeded to the École des Mines before preparing his doctoral thesis at the University of Paris, in which he used differential equations to model the motion of the solar system. He spent his career between academia and engineering, both teaching at the University of Paris and serving as a mining engineer in the Ministry of Public Services. In 1887, he famously solved the three-body problem in classical mechanics, originally set forth by Sir Isaac Newton[47].

Interestingly enough, Poincaré's cousin, Raymond, would eventually become the president of France in 1913, one year after Henri's death. He would also serve three separate terms as France's prime minister.

Building 2, Southern Face
Philosophers and Electrical Pioneers



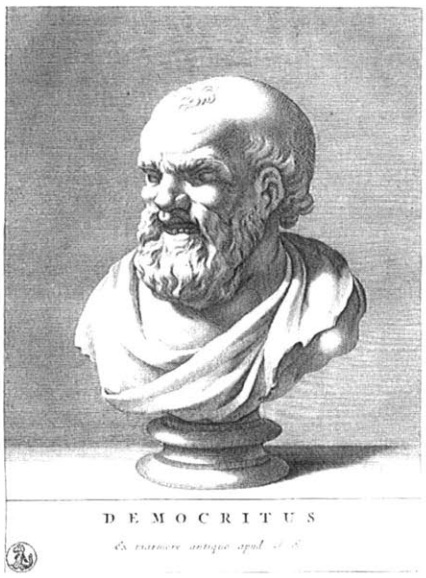
4.1 - Franklin

Benjamin Franklin (1706-1790), was a world-renowned political theorist, scientist, and diplomat, as well as one of the founding fathers of the United States. As a scientist, he advanced human knowledge of electricity, primarily through experimentation. A true Renaissance man, Franklin's work was restricted to no particular field, and his civic and political activities in many ways outreach his scientific influence. A lifelong tinkerer, he is also known for his invention of the lightning rod and bifocal glasses, among others[48]. His face is depicted on the American $100 bill.

Born to a middle-class family in Boston in 1706, Franklin was one of ten children. His father could afford to educate him for only two years, and his formal schooling ended at the age of ten. He would work at his brother's printer shop until the age of seventeen, when he would run away to Pennsylvania and found the Library Company of Philadelphia four years later. By 1734, Franklin was an established magnate in the printed word and held significant political power in Pennsylvania, allowing him to diversify the practices of his already eclectic interests[49]. A prolific inventor, he never filed for a single patent, claiming, "... as we enjoy great advantages from the inventions of others, we should be glad of an opportunity to serve others by any invention of ours."[50] In his electromagnetic research, Franklin was the first to label positive and negative electric dipoles and discovered the conservation of charge. His famous kite experiment proved that lightning was, in fact, a form of electricity (though it should be noted that Franklin was grounded for his experiment; other scientists attempting to replicate his findings were not so lucky[48]), and his work eventually led to his invention of the lightning rod. In 1762, Franklin was awarded an honorary doctorate from Oxford for his scientific accomplishments, despite his mere two years of formal education. In the final thirty years of his life, Franklin would go on to play a significant role in shaping the American Revolution, serving as a member of the committee to draft the Declaration of Independence, which he would later sign. He served as ambassador to France until 1785, a post that played an integral role in the winning of the Revolutionary War.

Franklin died five years later at the age of 84 and had over 20,000 people in attendance at his funeral[49].

Among so many prolific scientific minds, it seems odd that a man primarily remembered as a statesman would find his place among the ten most prominent names featured on MIT's buildings. Correspondences with President Maclaurin at the time indicate that Franklin wasn't originally considered, but as the great list narrowed, his place in history as one of the few noted American scientists of the era undoubtedly played a role in his selection[4]. His name presides over those who meet at the unusual intersection of philosophy and electromagnetic science, characteristic of the true polymath Franklin was.

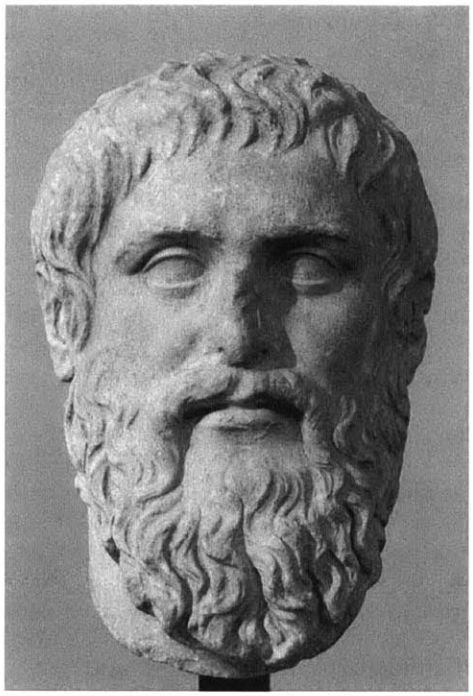


4.2 - Democritus

Democritus (460-370 BC) was a pre-Socratic philosopher who some consider to be the "father of modern science"[51], mainly due to his conceptualization of an atomic theory in antiquity.

Democritus was born in Thrace (part of modern-day Greece), though there is some dispute as to the actual date of his birth (most scholars accept a year between 470 and 460 BC). As a young man, he received a significant inheritance from his father, which he used to travel the known world, including Asia, India, and Egypt[52]. His learning abroad heavily influenced his work in natural philosophy, and, thanks to his wealth, he was able to not only purchase, but also study and critique the writings of his contemporaries. Among these, Democritus most aligned his thinking with that of Leucippus, the founder of atomism. He sought to define the physical world in a mechanistic sense, rather than rationalizing phenomena with supernatural explanations. This unusually modern style of thought for the period is why Democritus is sometimes known as the "father of modern science."

Democritus is popularly known as the "Laughing Philosopher," though it seems historians have distorted the meaning of the moniker over the course of time. While it may have been that he was simply a cheerful fellow, some authors, such as Seneca, interpret his humor as mocking or taking delight in the foolishness of others. The term *Abderitan laughter* (scoffing) is in fact derived from the name of Democritus's school of thought[51].



4.3 - Plato

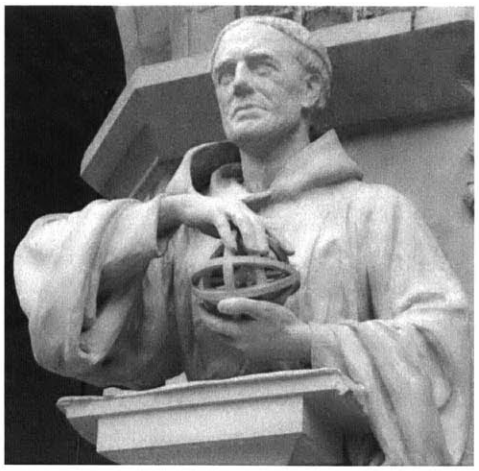
Plato (428-347 BC) was a classical Greek philosopher who studied under Socrates, tutored Aristotle, and founded the Academy in Athens. His ideas on logic, ethics, and rhetoric have laid the foundation for much of modern Western philosophy, and he lends his name to the concept of a Platonic ideal.

Though relatively little is known about Plato's upbringing, scholars are certain he came from a very wealthy and influential family in Athens, ensuring the philosopher's schooling by the best Athenian teachers available. He studied under Socrates, though scholars debate the exact nature of their relationship. Generally, it is accepted that the two were close, and Plato is widely recognized as Socrates's brightest pupil. After his teacher's death, Plato blossomed as a philosopher, producing writing that still influences philosophical thought today. He started his Academy, where he took on many students, including Aristotle, and it would stand for over two hundred years[53].

4.4 - Averroes

Averroes (1126-1198) was an Andalusian Muslim philosopher who was heavily involved in the popularization of Aristotelian philosophy in Europe. Sometimes described as the "founding father of secular thought in Western Europe"[54], Averroes often was forced to defend his beliefs, which many Muslim groups considered controversial. The result was a highly secular view of Aristotelian philosophy, which resulted in movements toward scholasticism in medieval Europe.

Born to a chief judge in Córdoba, Al Andalus (modern-day Spain), Averroes showed aptitude in a variety of fields from a young age and gained notoriety for his skill in medicine. Over the course of his life, he produced over 20,000 pages on philosophy, logic, and medicine, while dabbling in mathematics, astronomy, in religion as well. In modernity, he is best known for his commentaries on the work of Aristotle, specifically, his rationalist approach to the texts in an era of rampant mysticism. By the 12th century, most of Aristotle's philosophy had been lost to the dark ages, but Averroes's writing led to a resurgence of the ancient philosopher's ideas. As his texts gained a foothold in Western philosophy, he became so critical to the study that thinkers such as Thomas Aquinas did not even need to refer to Averroes by name, referencing him only as "The Commentator"[55].



4.5.1 - Roger Bacon

Roger Bacon (~1214-1294) was an English philosopher credited for being one of the early adopters of the scientific method. Though interpretations of his work have changed and developed over time, he is generally considered to be one of the first known experimental scientists[56].

Bacon was born at the Ilchester Friary in Somerset, England, though the exact year of his birth is unknown. He most likely received his M.A. from Oxford, then later moved to Paris (historians can accurately place him there in 1251), where he is known to have become a member of the Franciscan order as early as 1257[57]. Over time, however, Bacon developed some disagreements with the Franciscans, and the local Cardinal, Guy de Foulques, requested some of Bacon's philosophical writings to address his complaints. When de Foulques was elected Pope Clement IV, Bacon had no choice but to respond with what eventually became his three famous works: *Opus Maius, Opus Minus,* and *Opus Tertium*, which detailed as wide-ranging fields as mathematics, astronomy, alchemy, and philosophy.

At the time of his selection for a place on the Maclaurin buildings, Bacon was considered to be a lone figure representing the scientific method in an era of ignorance, though modern evidence tells a much more nuanced story. Scholars have found increasing evidence pertaining to the nature of medieval science, and, while he may have led in his field, Bacon was almost certainly not alone in his experimental pursuits. Modern scientific historians view the thirteenth century as a period characterized by burgeoning methods of thinking, upon which Bacon most likely elaborated and improved[56].

4.5.2 - Francis Bacon

Sir Francis Bacon (1561-1626) was an English philosopher, scientist, and statesman known for his use of inductive reasoning and empiricism. His writing and science helped to establish the scientific method, sometimes referred to as the Baconian method, as the basis for empirical research.

Born in London, Bacon was consistently in poor health as a child, and he thus received most of his early education at home. As a teenager studying at Trinity College, he grew to detest Aristotelian philosophy, an attitude he would hold for the rest of his life. In 1576, he began a tour of Europe that would grow his view of politics and legal philosophy before his return home in 1879. He was elected to parliament in 1581, beginning a busy political career in which he held a great number of posts. As a lawmaker, Bacon was more liberal than most, owing to his skeptical attitude toward the status quo. He was eventually was knighted by King James 1 in 1603, from which point on he had considerable influence on the throne. In 1621, Bacon's parliamentary career came to an abrupt halt when political enemies tried and convicted him of corruption, though he was quickly pardoned by the king. Stripped of his nobility, he died of pneumonia five years later[58].

Despite his primary role as a political figure, Bacon had a profound influence on the development of scientific thought. Unlike many of his peers, however, his contributions were almost entirely literary. Nonetheless, the spirit of Bacon's style of thinking and his philosophical influence on the nature of scientific attitudes during the Renaissance cannot be overlooked.

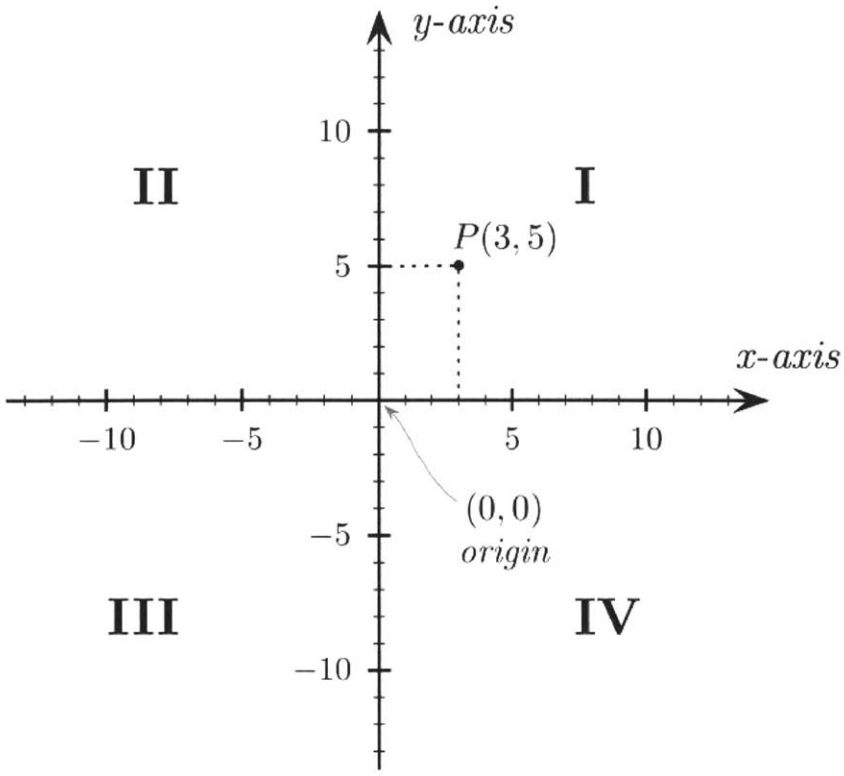
It is unknown whether Francis or Roger Bacon was intended to be included on the buildings. While Elihu Thompson explicitly mentioned Roger in a letter to Maclaurin[4], Francis Bacon is the more notable name and seems the better fit in relation to Franklin. Since the final list was only comprised of surnames, it very well may have been that the discrepancy was unclear even to those involved in the final selection process.

4.6 - Descartes

René Descartes (1596-1650) was a French philosopher and mathematician generally known as both the father of analytical geometry and modern philosophy. He gave the world the Cartesian coordinate system, which bears his name, and is known for his famous quote, "Cogito ergo sum," or "I think, therefore I am."[59]

The French town of Descartes's birth in 1596, originally La Haye en Touraine, now bears his name. Growing up part of a noble family, he was formally schooled before receiving his degree in law from the University of Poitiers at the age of twenty, though he secretly harbored ambitions to become a professional military officer[59]. Studying as a military engineer, Descartes discovered the need to bridge the gap between mathematics and physics, and it was near this time that he developed his famous coordinate system. In 1629, he established himself in the Dutch Republic, where he would conduct his work in mathematics and philosophy for the next twenty years. He died in Stockholm in 1650 on a visit to Queen Christina of Sweden.

Though Descartes believed both the fields of mathematics and philosophy to be fundamentally intertwined, the academic divergence of the studies has resulted in a bifurcation legacy into two separate, though perhaps equally deep-reaching partitions. In addition to his invention of Cartesian coordinates, Descartes was also responsible for the notation convention of using superscripts to denote exponents. In philosophy, his brand of mind-body dualism began a conversation that still has a profound influence on modern philosophical thinking[60].



The Cartesian coordinate system

4.7 - Pascal

Blaise Pascal (1623-1662) was a French mathematician, physicist, and philosopher famous for his work in both mathematics and hydrostatics. He is credited with inventing both the mechanical calculator and the syringe, and, along with Pierre de Fermat, he developed probability theory in mathematics, including the notion of expected value. The modern SI unit for pressure bears his name[61].

A child prodigy, Pascal was born in 1623 in Clermont-Ferrand, France, before moving to Paris after the death of his mother. He was educated by his father, and at the age of sixteen he developed what is still known today as Pascal's Theorem in Geometry. In order to rescue his family from financial ruin when he was eighteen, Pascal developed the mechanical calculator, the design of which he would continually improve over the course of his life. For the next twenty years, he would continue to study the effects of hydrostatics and barometric pressure as well as probabilistic mathematics and philosophy. Pascal lived in relatively poor health for the majority of his adult life, and he died at the age of 39[62].

1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1

Pascal's Triangle

Often discussed by historians is the matter of Pascal's spiritual beliefs. He was a devout Catholic, though for a short period he entertained ideas of the emerging Jansenist sect (which his

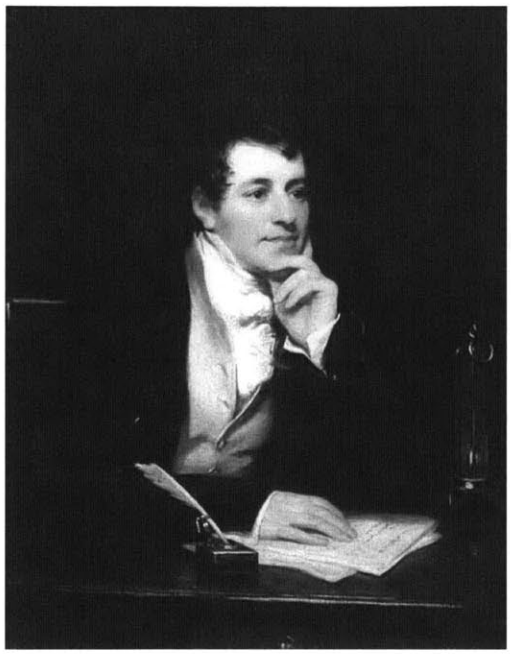
sister joined the sect in 1651), and his faith often found a place in his writing. He was openly critical of Rene Descartes's philosophy, claiming, "Descartes did his best to dispense with God. But Descartes could not avoid prodding God to set the world in motion with a snap of his lordly fingers; after that, he had no more use for God."[63] His most famous religious writing is *Pascal's Wager*, which attempts to make a probabilistic argument for a belief in God and a life in abidance with the laws of the church.

4.8 - Napier

John Napier (1550-1617) was a Scottish mathematician and physicist best known as the inventor of logarithms. He is also responsible for introducing the use of the decimal point in mathematical calculation[64].

Born at Merchiston Tower in Edinburgh, Napier was born to a noble family, though his father was only 16 years old at the time of his birth. After a brief period of schooling in Scotland, scholars believe he travelled to mainland Europe to continue his learning. He returned home at the age of twenty-one to buy a castle at Gartness, where he would stay until the death of his father in 1608, upon which he would relocate to Merchiston. In 1614, he published his main work, *Mirifici Logarithmorum Canonis Descriptio*, which contains his invention of logarithms.

Despite his critical findings in mathematics, Napier considered his most important work to be a religious one. Harboring an intense interest in the Book of Revelation, he published a prediction of the apocalypse in 1593 in *A Plaine Discovery of the Whole Revelation of St. John*. He believed the end of the world would take place in either 1688 or 1700, and his writing was translated into multiple languages[65].



4.9 - Davy

Sir Humphry Davy (1778-1829) was an English chemist famous for his discoveries of several alkali and alkaline earth metals on the periodic table, including sodium and potassium. He was the first chemist to discover an element using electrolysis, and he gained a large following in London for his popular, and often exciting, lectures.

Born in Cornwall, Davy had a modest education before assuming an apprenticeship with an apothecary at the age of fifteen. He eventually assumed the role of an assistant to Dr. Thomas Beddoes in Bristol, under whom he became known for his work with nitrous oxide (laughing gas). Though he never thought to use the gas as an anesthetic, some scholars do maintain that Davy himself became addicted to it, and there are multiple recorded instances in which he came close to death due to his own experiments[66]. In 1801, Davy joined the Royal Institution as a lecturer in chemistry, where he would expand his work on galvanism. There, he gained notoriety as a spectacular lecturer, attaining a full position at the age of twenty-three. In 1812, a laboratory accident damaged Davy's eyesight, prompting him to hire Michael Faraday as an assistant, whom he would later accuse of plagiarizing his work[67]. Davy succumbed to heart disease in 1829.

Among Davy's impressive feats was his invention of the world's first electric light in 1809. Davy's initial design merely connected a piece of charcoal to a pair of charged wires, but he was able to refine his crude arc lamp into a useful tool for miners, who frequently died in methane explosions from open flames[67]. Over the next few decades, the "Davy Lamp" would save countless lives.

Cartoon of Davy at one of his famous lectures

4.10 - Regnault

Henri Victor Regnault (1810 – 1878) was a French physicist and chemist famous for his work on gas properties and thermodynamics. He also worked as an assistant to Joseph-Louis Gay-Lussac and served as a mentor to Lord Kelvin[68].

Orphaned at a young age, Regnault grew up in relative poverty before his academic capabilities granted him entry into the Ecole Polytechnique in Paris. After his graduation in 1832, he traveled Europe studying mining and metallurgy for four years before returning to work under Gay-Lussac. In 1841, he became a professor at the Collège de France, where he would conduct his famous work on the thermal properties of gases. Regnault's scientific career was brought to an abrupt halt in 1871, when soldiers destroyed his laboratory and many of his instruments in the Franco-Prussian War. His son was also killed in the fighting, and Regnault was never able to psychologically or scientifically recover[68].

Though history is somewhat unclear, ideal gas constant, R, may have been chosen in honor of Regnault. His research in gases led to the constant's discovery, but it is equally likely that when French Engineer Benoit-Paul Emile Clapeyron first declared the constant, he might have been simply abbreviating the word "ratio" (in French, "raison" or "rapport")[69].

4.11 - Foucault

Léon Foucault (1819 – 1868) was a French physicist famous for measuring the rate of rotation of the Earth with a giant pendulum. He is also known for his early measurements of the speed of light, his discovery of eddy currents, and his improvements to telescopes and daguerreotype photography[70].

Born in Paris, Foucault was in consistently poor health as a child. As a result, he was schooled at home before concentrating his studies in medicine, though his squeamishness with blood eventually forced him to switch his focus to physics. He maintained a broad focus in his experiments, working on theory of light, fluid mechanics, and gyroscopes. His experiments all had many practical applications, the most noticeable of which were his improvements in telescope technology[69].

Regarded as somewhat of a tinkerer by his more academically-focused peers[71], Foucault spent his years conducting experiments in a home laboratory, typically avoiding universities. It was in such a home lab that he originally built his famous pendulum:

Building 4, Northern Face
Earth and Life Scientists

5.1 - Pasteur

Louis Pasteur (1822 – 1895) was a French chemist and biologist best known for his research in vaccination and disease prevention that has saved innumerable human lives. He lends his name to the process of pasteurization for milk and wine, and he developed the first vaccine for rabies. Known as the main discreditor of the theory of spontaneous generation, Pasteur is commonly referred to as the "father of microbiology"[72].

Born the son of a tanner in Jura, France, Pasteur began his academic life as an average student. Expressing minimal scholastic interest, he struggled in his educational pursuits, eventually earning a B.S. from the École Normale Supérieure in 1845. He spent his years afterward studying crystallography before the premature deaths of three of his five children from typhoid inspired him to search for causes and cures of infectious diseases[73]. He held various professorships and administrative positions at the University of Strasbourg, Lille University, the École Nationale Supérieure des Beaux-Arts, and his own alma mater, eventually resigning in 1867. He later founded the Pasteur Institute in Paris, the goal of which was to advance biological research and practical applications for modern scientific developments. There are now 32 separate Pasteur Institutes in 29 countries across the globe.

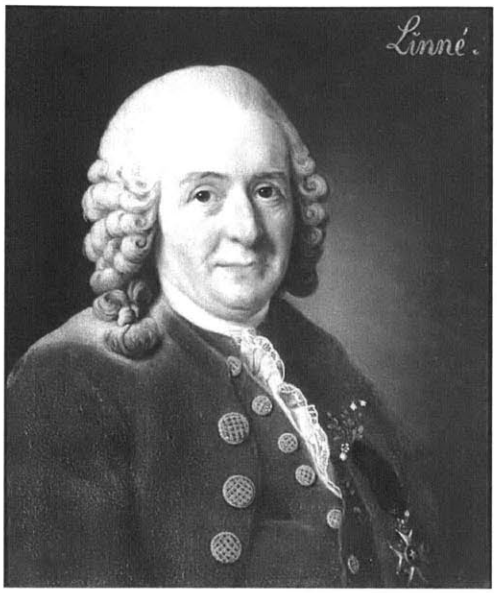
Despite his life-saving advances in vaccination and germ theory, Pasteur never obtained a medical license and often violated basic codes of medical ethics. The tests for his vaccines were considered haphazard by the medical community for their avoidance of pre-clinical trials and proper procedure. Nonetheless, Pasteur's medical shortcomings are often forgiven by the scientific community in light of the countless lives he has saved[72].

5.2 - Harvey

William Harvey (1578-1657) was an English physician famous for his theories on blood circulation. His work also contributed to human understanding of the brain as the body's nerve center

Born to a middle-class landowner in Kent, England, Harvey attended King's School in Canterbury as a youth. He moved on to Gonville and Caius College at Cambridge to continue his education, where he began his interest in medicine before matriculating to the University of Padua in 1600. At the time, Padua was the leading medical school in Europe, and, having received the best available mentorship, Harvey was well-prepared to begin practicing medicine in London after he received his doctorate in 1602. Five short years later, he became a fellow of the Royal College of Physicians, for which he would serve as a surgery lecturer for over 40 years. He died in the house of one of his six brothers in 1657[74].

Harvey's medical advances may not have been possible were it not for the help of the Crown. Harvey became physician to King James I in 1618 and maintained his position into the reign of King Charles I. After an excursion to Italy to procure paintings for the royal collection, Harvey left an impression on King Charles, who became interested in his work. From then on, Harvey's research cadavers were supplemented with live deer from the royal parks[75].



5.3 - Linnaeus

Carl Linnaeus (1707-1778) was a Swedish botanist and zoologist responsible for most modern biological taxonomy conventions. In addition to accomplishing the tremendous task of categorizing every known plant and animal, he also contributed heavily to the early study of ecology.

Born in southern Sweden, Linnaeus expressed a deep interest in natural history as a youth. After a brief stint at Lund University when he was 21, Linnaeus matriculated to Uppsala University for its better programs in botany. There, he befriended Olof Celsius, who collaborated with him in his botanical research. Around 1730, he began to realize a need for reform in the current system of botanical taxonomy, based on his new theory of plant sexuality. After multiple expeditions to further his studies, Linnaeus became a professor of botany at Uppsala in 1742, where he would remain for the rest of his years, renovating the university's gardens and furthering his research. In 1753, he completed the *Species plantarum*, an exhaustive taxonomy over every known living creature. It was his proudest accomplishment and his life's greatest work[76].

5.4 - Jenner

Edward Jenner (1749-1823) was an English physician often referred to as "the father of immunology". He developed the world's first vaccine, saving millions from smallpox. He is also responsible for coining the term "virus".

Jenner was born in Berkeley, to a prominent family. His parents died when he was five years old, and he was brought up by his eldest brother, who took control of the household. From his family's wealth, Jenner received a strong education, eventually moving to London to study anatomy and surgery. He returned home in 1773 to practice medicine with his brother, securing his financial wellbeing. He was pushed by his brother to continue his study of natural science, and in 1780, Jenner noticed a pattern of immunization from smallpox that took place in milkmaids who dealt with the rather similar cowpox virus. With no way to test his hypothesis, Jenner sat on his idea for sixteen years until the opportunity finally arose to inoculate the eight-year-old James Phipps, who then survived direct exposure to smallpox. For almost the rest of his life, Jenner toured Britain, spreading the knowledge of his procedure.

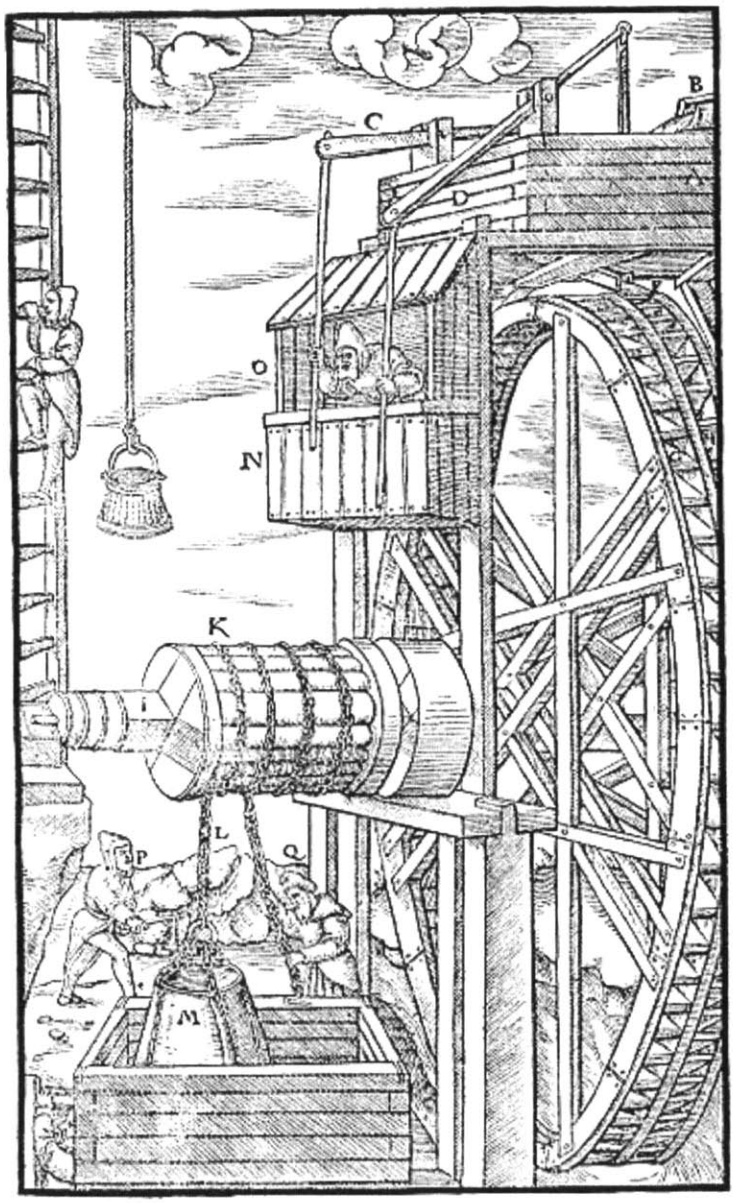
Jenner's medical innovation even crossed battle lines. In 1805, despite a war with Great Britain, Napoleon made smallpox vaccination mandatory for his soldiers. He had a medal made in Jenner's honor, and the physician was even able to request the release of certain fellow countrymen who had been taken captive in the conflict[77].

5.5 - Agricola

Georgius Agricola (1494-1555) was a German scientist generally known as the "father of mineralogy". His book, *De re metallica,* was the de facto text about extractive metallurgy for over two centuries.

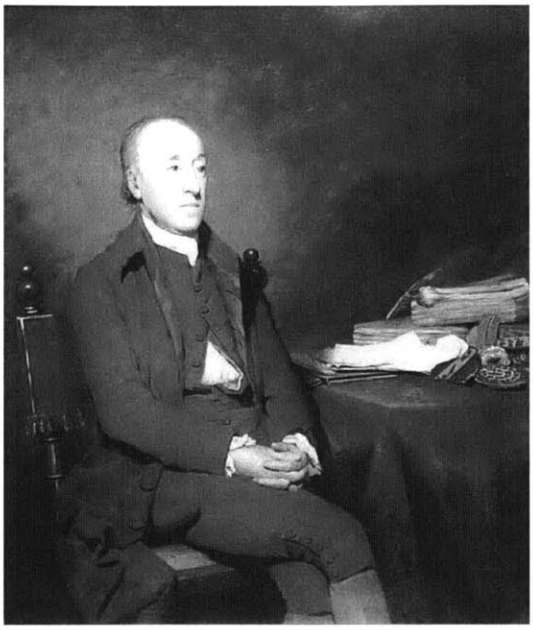
Agricola was born in Glauchau, Germany in 1494, where he received his elementary education, though he was five years older than most of his classmates when he matriculated to Leipzig University in 1514, mainly due to health concerns when he was a child. While there, he simultaneously entertained interests in medicine and metallurgy until 1530 when one of his publications brought him to the attention of Prince Maurice of Saxony, who appointed Agricola to the position of historiographer. With his new position, Agricola was able to observe the mining industry in the town of Chemnitz, where he eventually published *De ortu et causis suberraneorum,* one of the world's first modern books on physical geology. Upon his death in 1555, the newly Lutheran Chemnitz denied the Catholic Agricola's burial, and his body had to be moved to the nearby town of Zeitz[78].

In 1912, Agricola's *De re metallica* was translated from its original Latin into English for publication in *Mining Magazine*; the translators: future United States president Herbert Hoover and his wife, Lou[79].



One of many extensive wood carvings required to print *De re metallica*,

Which took so long to make, it wasn't released to the public until after Agricola's death.



5.6 - Hutton

James Hutton (1726 – 1797) was a Scottish geologist famous for his theory of uniformitarianism, one of the fundamental principles of the science. He used the process of sedimentation to develop a theory of geologic time pertaining to the history of the Earth. For his extensive work to legitimize geology as a scientific field, Hutton is commonly known as the "Father of Modern Geology".

Born in Edinburgh, Hutton was the only son among five children. After his father died when he was three, Hutton's mother convinced him to stay close to home, and he decided to attend Edinburgh University at the age of fourteen. At Edinbugh, Hutton was educated by famous mathematician Colin Maclaurin, but the pursuit of a professional career drew him away from the academic life. After failing as a lawyer, he switched his focus to medicine, which he studied until 1750 before abandoning the practice for a life in agriculture. For the next seventeen years, Hutton developed an interest in geology while working on his farm, which he eventually abandoned to study rock formations around Scotland. Though he developed many of the elements of his theories of geology over twenty years earlier, Hutton did not announce any intent to publish his work until 1785[80].

Unfortunately for Hutton, the true extent of his findings was not known until well after his death. His opus, *Theory of the Earth; or an Investigation of the Laws observable in the Composition, Dissolution, and Restoration of Land upon the Globe* was, somewhat unsurprisingly, untenably verbose, and its two thousand-odd pages of length dissuaded even the most voracious readers from picking it up to study[81].

5.7 - Lyell

Charles Lyell (1797-1875) was a Scottish geologist most famous for his book, *Principles of Geology*, which built on the work of James Hutton and established geology as an empirical science. He was among the first modern scientists to postulate that the world was older than 300 million years[82].

The oldest of ten children, Lyell attended nearby boarding schools as a youth before matriculating to Exeter College in Oxford in 1816. At Exeter, he developed a fervent interest in geology and in three short years was elected to fellowship in the Geological Society of London. Though he was simultaneously learning to be a lawyer, issues with his eyesight made reading burdensome, and by 1827, Lyell had fully dedicated himself to a life studying geology[83]. To facilitate his research, he traveled across most of the European continent, and during the 1840's, he made two trips to North America, from which he produced two books. Lyell died in 1875 and was buried in Westminster Abbey.

Much like astronomers centuries before, Lyell often had to deal with backlash from the church for his views, especially those pertaining to the age of the Earth. Lyell's proposed model of uniformitarianism stood in direct opposition to popular models such as catastrophism, which allowed for both a younger Earth and events such as the Biblical flood. It is no coincidence that Lyell developed a deep friendship with another contemporary who had to deal with religious opposition: Charles Darwin[82].

5.8 - Dana

James Dwight Dana (1813-1895) was an American geologist and zoologist among the first to conceive of tectonic plates and their effect on topography.

Born in Utica, New York, Dana showed an interest in science from a young age, which he sought to foster upon his acceptance to Yale in 1830. He graduated in 1833 and, lacking means to fund a life of research, joined the United States Navy. His naval experience proved useful in helping his selection to the United States Exploring Expedition, a four-year globetrot that allowed Dana to conduct geological surveys Polynesia and, among other things, confirm the existence of Antarctica. Dana would spend his next thirteen years writing about his discoveries during his travels, and he quickly became the foremost geologist in North America. He continued his studies, concentrating in volcanism in the Pacific, until his death in 1895[84].

Dana possibly stands alone as the only geologist to ever have a significant influence on American culture. During the peak of his career, prospectors began to find gold in California, and, as the nation's most prominent geologist, Dana's writing convinced many to join the famous gold rush of 1849[85].

5.9 - Suess

Eduard Suess (1831-1914) was an Austrian geologist known for his work on the structure and foundation of the Alps. He also hypothesized the southernmost supercontinent of Pangea, called Gondwana, as well as the Tethys Ocean that existed between the ancient northern and southern supercontinents.

Suess was born in London, but his family soon moved to Prague when he was three. He retained his knowledge of English while simultaneously learning French and German, giving him a leg up in his studies as a youth and in his future travels (he would later add Russian to his repertoire[86]). After attending the University of Prague, he became a professor of paleontology at the University of Vienna in 1856 and a professor of geology five years later, the entire time spending his summers away on geological excursions around Europe and northern Africa. In addition to his geologic studies, Suess had a mind for politics; he was elected to Parliament and was even proposed as a possible Secretary of State for Education in Austria. These skills were also put to use in his academic life, in which he was known to be expert at procuring funds for his various geological journeys.

In 1915 when his name was selected to be placed on the Maclaurin buildings, Suess's geology textbook, *Das Antlitz der Erde (The Face of the Earth)*, was one of the most popular in the field. A significant number of the ideas in the book, however, have been proven wrong or corrected since its 1901 publishing. Suess based many of his hypotheses on the idea of contractionism, which assumes that the Earth is slowly cooling down and shrinking[86]. Modern geologists now know this not to be the case.

5.10 - Bessemer

Sir Henry Bessemer (1813-1898) was an English engineer known mainly for his process for steel manufacture, which was a critical component of the industrial revolution. He is among the most celebrated of nineteenth-century inventors.

The son of a career inventor, Bessemer's future profession was cast in stone from an early age. As a self-taught engineer, he learned metallurgy at his father's foundry as a boy, and at the age of twenty-one, he developed a process for making bronze powder[87] (used in the production of gold paint), that earned him wealth and notoriety. The Crimean War prompted Bessemer to develop weapons technology, specifically, stronger canons to fire long-range artillery. From 1850-1855, he developed what would come to be known as the Bessemer process for steel manufacture, which grew to near-ubiquitous use for structural steel and railways[88].

As celebrated as the Bessemer process is, it was not without its original difficulties. Phosphorus impurities in British iron yielded Bessemerized steel that was either too brittle or unmalleable, an issue that was only discovered after Bessemer had filed his patent and delivered machines to manufacturers (Bessemer had, by chance, used pure iron in his development of the process). Despite this shortcoming, he profited greatly from his invention, allowing later scientists to determine how to remove the iron impurities[88].

Building 4, Western Face
Chemists

6.1 - Lavoisier

Antoine Lavoisier (1743-1794) was a Frenchman considered by many to be the father of modern chemistry[89]. He developed the first list of elements, including oxygen, hydrogen, and sulfur, all of which he was the first to identify, as well as silicon, which was had not been physically discovered at the time. A dedicated public servant, he also aided in the development of the metric system.

Born to a wealthy Parisian family, Lavoisier received his early education in the Collége des Quatre Nations, from which Jean le Ronde D'Alembert was a notable alumnus. At the age of twenty, Lavoisier received a degree in law, his father's profession, but in his spare hours as a student he had developed a passion for science, especially in the field of mineralogy. While family friends debated Lavoisier's future, the young graduate found his way into the lectures of Guillaume François Rouelle, who, though a chemist, included elements of mineralogy in his teaching. He began working with Rouelle independently and in 1765 was admitted to the Academy of Sciences, where he would come to serve on many committees, allowing him to form numerous relationships with his contemporaries, including Benjamin Franklin[90]. These relationships undoubtedly paid dividends toward his future career in government, and he eventually became an administrator of the French National Treasury.

Unfortunately, Lavoisier's political status made him a target during the French Revolution. The Reign of Terror in 1794 saw him and his father-in-law arrested under the orders of Maximilien de Robespierre, and they both were quickly sentenced to death on May 8 of the same year. After Lavoisier met the guillotine, Joseph-Louis Lagrange was quoted, "It took them only an instant to cut off that head, and a hundred years may not produce another like it"[89].

6.2 - Boyle

Robert Boyle (1627-1691) is generally regarded as the first modern chemist. He is best known for Boyle's law, which states that the pressure in a gas is inversely proportional to its volume when the gas is held at a constant temperature[91].

Born in Lismore, Ireland, Boyle was the youngest of fourteen children. He was tutored at home until the age of eight then began an education abroad, during which time he discovered the writings of Galileo in Florence. The English Civil War quickly brought Boyle home in 1642, but his experiences in Florence drove him to the field of medicine. In his preparation of various drugs, he discovered himself to be a talented chemical experimenter, and he quickly read the limited chemistry texts of the era, moving to Oxford in 1654. Though he primarily saw himself as a chemist, Boyle first gained notoriety through his 1660 book on pneumatics, *New Experiments Physico-Mechanicall, Touching the Spring of the Air and its Effect,* which detailed the gas law that would later bear his name[92]. His status in the scientific community brought him to London in 1668, where he would help found the Royal Society. In 1680, he declined election to the presidency to the Society in favor of concentrating on his work, which was, at that point, voluminous. He died in the December of 1691.

After Boyle's death, a "wish list" of sorts was found among his possessions. It detailed 24 scientific advancements he hoped to see eventually accomplished. His (unedited) list[92]:

- The Prolongation of Life.
- The Recovery of Youth, or at least some of the Marks of it, as new Teeth, new Hair colour'd as in youth
- The art of flying.
- The Art of Continuing long under water, and exercising functions freely there.
- The Cure of Diseases at a distance or at least by Transplantation.

- The Emulating of Fish without Engines by Custome and Education only.
- The Acceleration of the Production of things out of seed
- The making of Parabolicall and Hyperbolicall Glasses.
- The making Armor light and extremely hard.
- The practicable and certain way of finding Longitudes.
- Potent Druggs to alter or Exalt Imagination, Waking, Memory, and other functions, and appease pain, procure innocent sleep, harmless dreams, etc.
- Pleasing Dreams and physicall Exercises exemplify'd by the Egyptian Electuary and by the Fungus mentioned by the French Author.
- Great Strength and Agility of Body exemplify'd by that of Frantick Epileptick and Hystericall persons.
- A perpetual Light.
- Varnishes perfumable by Rubbing.
- The Transmutation of Species in Minerals, Animals, and Vegetables.
- The Attaining Gigantic Dimensions.
- The making of Glass Malleable.
- Freedom from Necessity of much Sleeping exemplify'd by the Operations of Tea and what happens in Mad-Men.
- The use of Pendulums at Sea and in Journeys, and the Application of it to watches.
- The Cure of Wounds at a Distance.
- The Transmutation of Metals.
- The Liquid Alkaest and Other dissolving Menstruums. [invention of a universal solvent]

6.3 - Cavendish

Henry Cavendish (1731-1810) was a British chemist and physicist most famous for his measurement of the mass of the Earth. In addition to his experiments with gases, he also was the first to develop the concept of electrical attraction (now known as Coulomb's Law, since he never published his findings)[93].

Though Cavendish was English, he was born in Nice, France, due to his mother's poor health at the time of his birth[94]. He was raised by his father after her death when Cavendish was two, and he received his education in London before continuing to St. Peter's College in Cambridge. He left without a degree (not particularly uncommon at the time) but quickly came into substantial wealth through inheritance from his well-off relatives. He took advantage of his father's connections to establish a place in the Royal Society of London in 1760 and, living in relative comfort, isolated himself to his research. An unusually shy man, Cavendish generally avoided the company of others in favor of his experiments (though toward the end of his career he did begin a partnership with Humphry Davy), but he still garnered the respect of all who knew him[94].

Cavendish secluded himself to the extent that he did not receive credit for many of his findings until after his death. He refused to publish any work with which he was not entirely satisfied, and the full extent of his genius was only revealed when others were allowed to dig through his manuscripts. A true polymath, Cavendish might have received credit for the conception of Coulomb's law of conductivity, Charles's law of gasses, and some of the basic governing equations of thermodynamics.

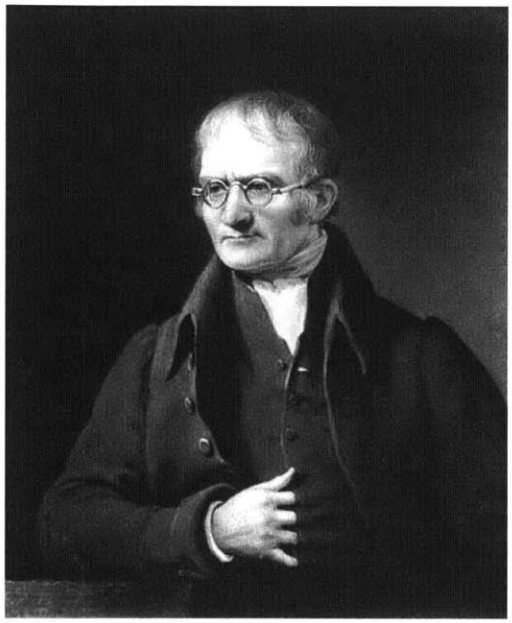
6.4 - Priestley

Joseph Priestley (1733-1804) was an English chemist known for his discovery of oxygen gas. A well-known theologian, he published over 150 works on a wide range of subjects over the course of his life.

Born in Yorkshire, Priestley was the oldest of six children in a Calvinist family. After the death of his mother when he was a child, Priestley moved in with his aunt, and he would stay in her custody for the next thirteen years. She quickly noticed Priestley's scholastic talents and sent her nephew to be educated, with the ultimate intent of seeing him join the clergy[95]. Priestley eventually moved on to the Daventry Academy, where he broke with the strict Calvinism of his parents to become a Rational Dissenter. Upon his graduation, he joined the ministry, but had little success as a preacher, opting instead to make his living as a private tutor. He eventually moved to an academy in Warrington, where he taught subjects as disparate as law and anatomy[96]. Priestley began his scientific career by writing *The History and Present State of Electricity* (1767), in which he included some of his own experiments and observations on the subject. The book's popularity inspired Priestley to generate other scientific texts and continue experiments, though his focus remained firmly on theology. Nonetheless, his hobby of science yielded results that gained him notoriety, specifically his invention of a process for creating soda water[95]. In 1773, Priestley abandoned his ministry for a position as an assistant to Lord Shelburne, who eventually became the British Prime Minister. The two parted ways in 1779, most likely due to tension caused by some of Priestley's more extreme religious views, and his public career never recovered. He moved to Philadelphia in 1794, and remained out of the political arena[96].

Priestley's outspoken attitude about his religious views earned him many enemies in England. In one pamphlet supporting Dissention, he wrote, "We are, as it were, laying gunpowder, grain by grain, under the old building of error and superstition, which a single spark

may hereafter inflame, so as to produce an instantaneous explosion," earning him the nickname "gunpowder Joe." In 1791, his home and laboratory were burned to the ground in a series of violent acts that were later named the "Priestley riots"[97].



6.5 - Dalton

John Dalton (1766-1844) was an English chemist known for his work on atomic theory. He also discovered the chemical law of definite proportions, and the unofficial atomic mass unit now bears his name[98].

Dalton was born part of a Quaker family in Cumberland. He entered a local boarding school in 1781, where he became the co-principal four years later. Driven by a natural curiosity, Dalton was a voracious reader, and he eventually was able to put his knowledge to use in 1792 as a lecturer at a newly established college for like-minded Dissenters in Manchester. In 1800, Dalton decided to resign his position in favor of starting his own academy for mathematics, which would support him for the rest of his life. He continued his work independently of his teaching obligations and developed the basis for modern atomic theory. In 1803, he published the first table of atomic weights, solidifying his already exceptional scientific reputation. Dalton continued to teach until he died of a stroke in 1844[99].

Unusual in Dalton's research was his work on colorblindness. Dalton was the first to ever formally describe the condition and, since both he and his brother were affected, postulated that it was hereditary. As a result of his research, colorblindness is sometimes referred to as Daltonism[100].

6.6 – Gay-Lussac

Joseph Louis Gay-Lussac (1778-1850) was a French chemist best remembered today for his laws regarding gases.

Born to a prominent family, Gay-Lussac found himself uprooted as a child because of the French Revolution. In 1793, his father was arrested, and the private tutor who had been in charge of his education fled the country[101]. He was sent to a boarding school in Paris and was eventually admitted to the Ecole Polytechnique in 1797. After his graduation, Gay-Lussac's aptitude in the civil engineering school earned him the notice of chemist Claude Louis Berthollet, who took him as an understudy. With Berthollet, he discovered the element boron in 1808, and he continued his research while working as a professor at the Ecole shortly thereafter. He eventually rose to the rank of chair of chemistry at the Jardin des Plantes, by which point he had also identified the element iodine. Gay-Lussac managed a brief political career in the 1830's, but his focus was only truly ever on scientific discovery[102].

In one of his most famous experiments, Guy-Lussac collaborated with Jean-Baptiste Biot to measure variations in Earth's magnetism with altitude. To accomplish this, the two ascended in a hot air balloon to a height of 4,000 meters to record their measurements. To lessen the load and achieve a greater height, Guy-Lussac attempted the experiment by himself a week later. His height of 7,016 meters above sea level would go unmatched for over fifty years[102].

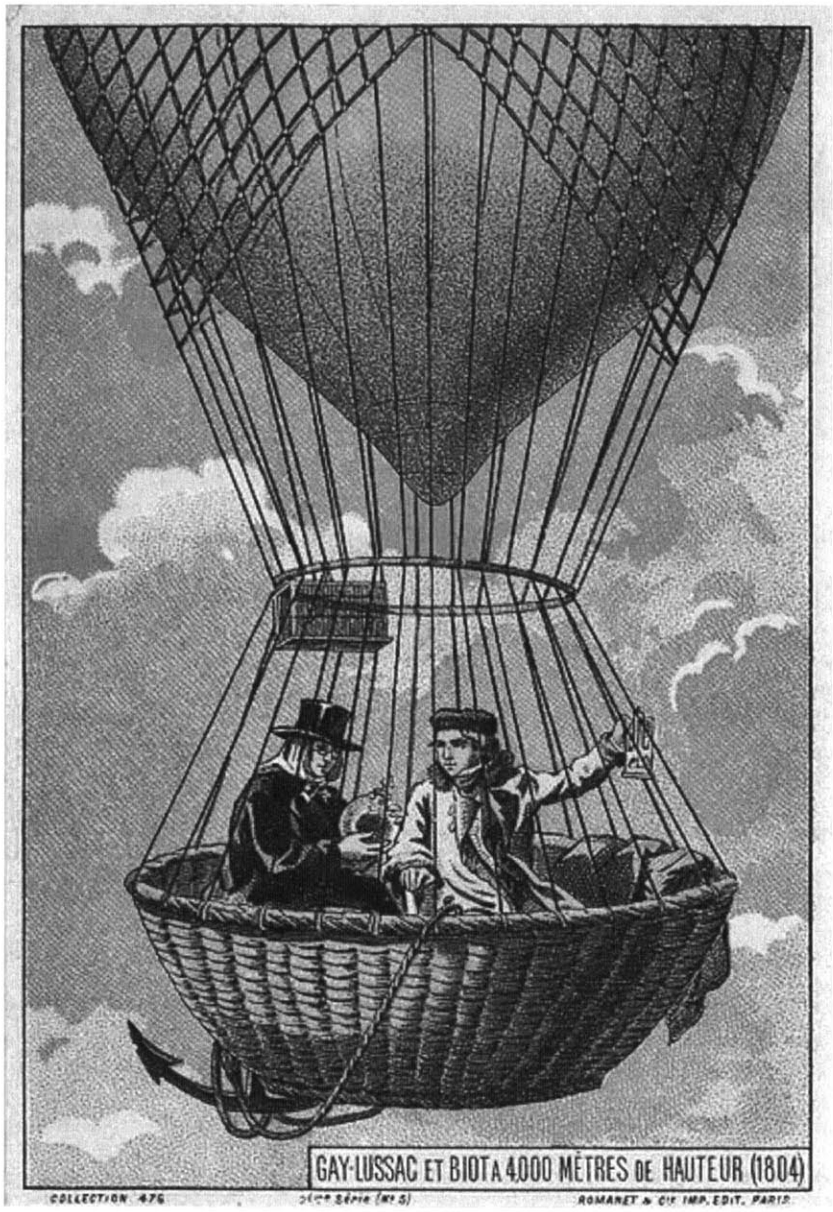


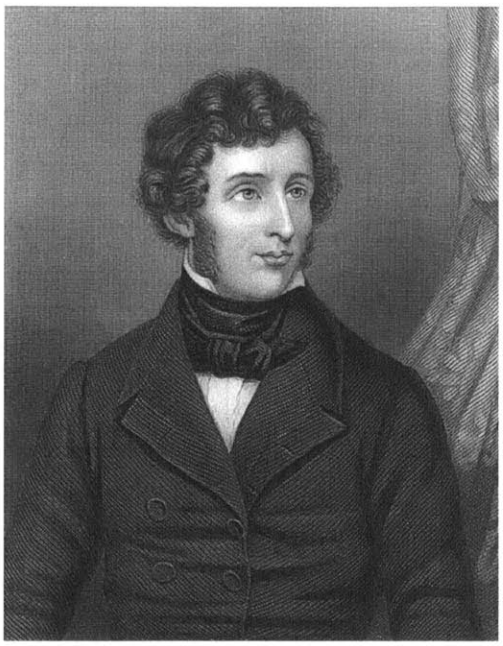
Illustration of Gay-Lussac and Biot in their hot air balloon

6.7 - Berzelius

Jöns Jacob Berzelius (1779-1848) was a Swedish chemist known for his work with atomic weights, the isolation of cerium and thorium, and the advancement of stoichiometry. He may be best remembered for his implementation of the common superscript chemistry notation used today[103].

Berzelius was born at Väversunda in Östergötland and was orphaned at the age of nine upon the death of his mother. He was raised by his uncle but as a teenager moved to a nearby farm, where he developed an interest in botany. 1798, he left to study medicine at Uppsala University, but his stepbrother instead steered him toward chemistry. Berzelius published his doctoral thesis on galvanic current in 1802 while still pursuing a medical degree, and he eventually took his M.D. to the College of Medicine in Stockholm, where he became a full professor after five years. He conducted his research in Stockholm for the rest of his life, producing a great volume of work[103].

Notable in Berzelius's life is his relationship with the other chemists of the time. As a young scientist, he was known to have ventured throughout Europe, meeting chemists such as Christian Oersted and Humphry Davy. As he advanced in years, Berzelius himself became a mentor to many young chemists, such as Friedrich Wöhler and Justus von Liebig[104], both of whom are featured next to Berzelius on the Maclaurin Buildings.



6.8 - Wöhler

Friedrich Wöhler (1800-1882) was a German chemist who isolated many different chemical elements. He is most famous for his synthesis of urea and his co-invention of the theory of isomerism[105].

Born in Frankfurt, Wöhler was publicly schooled but received supplementary instruction as a child to prepare him for an advanced education. He eventually graduated from Heidelberg with an M.D., specializing in gynecology, and he found work under Jöns Jakob Berzelius, who convinced Wöhler to pursue a life of chemistry. In 1825, he was acquainted with Justus von Liebeg while working with Berzelius, and the two became lifelong friends. Together, they furthered Berzelius's work to develop the theory of isomerism. Integral in their collaboration was Wöhler's synthesis of uric acid, itself an isomer, for which he became quite famous. Dedicated to his research, Wöhler would work diligently in his laboratory until his death at the age of eighty-two[105].

The process for creating urea is now known as Wöhler synthesis and, in many ways, is responsible for the birth of organic chemistry. The synthesis produces an organic compound from two inorganic reactants, disproving the theory of vitalism, which was widely held at the time. Like so many other discoveries, Wöhler's process was a happy accident during an attempt to prepare ammonium cyanate for a different experiment. Upon his discovery, he famously wrote to Berzelius: "I can no longer, so to speak, hold my chemical water and must tell you that I can make urea without needing a kidney, whether of man or dog; the ammonium salt of cyanic acid is urea[106]."

6.9 - Liebig

Justus von Liebig (1803-1873) was a German chemist known for his contributions to organic chemistry with Friedrich Wöhler. He was a prodigious teacher, and among his students was Victor Regnault[107].

Born in Darmstadt, Liebig developed an interest in chemistry when he was a child. He was apprenticed to an apothecary as a teenager before attending the University of Bonn. When his mentor, Karl Wilhelm Gottlob Kastner, moved to the University of Erlangen, Liebig followed him, staying at Erlangen until 1822, at which time he received a grant to work with Joseph Louis Gay-Lussac in Paris. At the age of 21, he became a professor of chemistry at the University of Giessen, where he remained until 1852. At Giessen, much of Liebig's work concentrated on fertilizers and agriculture, most likely a result of him having lived through a global famine in 1815. During this time he also worked with Wöhler and Jöns Jacob Berzelius on the concept of isomerism and developed a vapor condensation device that now bears his name. In 1852, Liebig was appointed to a professorship at the University of Munich, where he remained until his death in 1873[108].

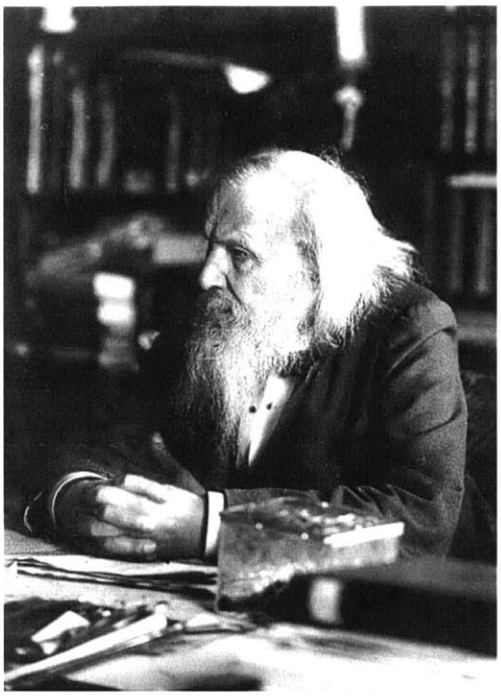
Among the most bizarre of Liebig's research findings was his work involving spontaneous human combustion in the early 1850's[107]. At the time, the idea that a human body could burn without added fuel had been popularized by novelists such as Charles Dickens and Herman Melville. To dispel the theories, Liebig performed experiments on both dry and wetted human bones, eventually concluding that such combustion was impossible[109].

6.10 - Bunsen

Robert Bunsen (1811-1899) was a German chemist who, along with Gustav Kirchhoff, developed the technique of spectral analysis. He is most famous for the gas burner that bears his name.

Born in Göttingen, Bunsen was the son of a philology professor at the local Göttingen University, where he would later matriculate. While studying, Bunsen learned from some prestigious names, including Carl Friedrich Gauss, who taught him mathematics. After earning his doctorate, he became a lecturer at Göttingen in 1833 and continued his research, the nature of which was often dangerous. He lost the use of his right eye in a laboratory explosion and was known to have had multiple brushes with arsenic poisoning, and he gained acclaim through his commitment to work in perilous conditions. After holding various positions at Kassel and Marbug, in 1852 Bunsen became a professor at the University of Heidelberg, where he conducted his seminal research on spectroscopy and developed his famous burner[110].

In almost every modern chemistry student's introduction to the Bunsen Burner, it is noted that Bunsen did not actually invent the device, but instead merely improved on an existing design. While the primary burner Bunsen modified was patented by engineer R.W. Elsner, he also borrowed design concepts from another source: Michael Faraday[111].



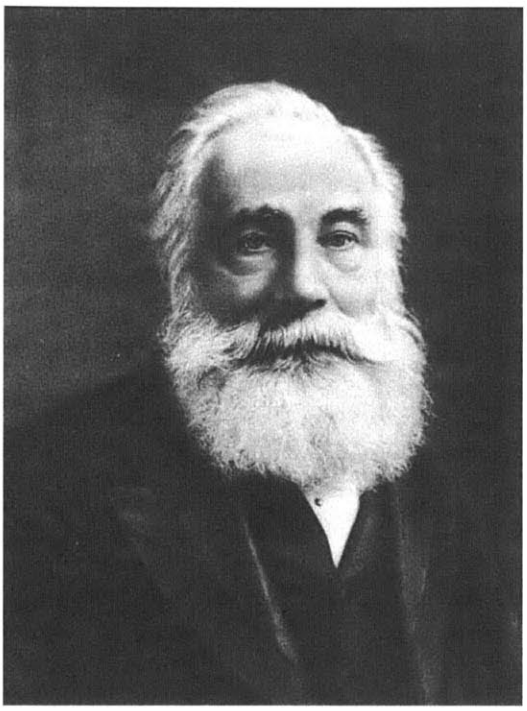
6.11 - Mendeleev

Dmitri Mendeleev* (1832-1907) was a Russian chemist famous for developing the periodic table of elements. His periodic law would be used by him and others to predict unknown elements, including element 101: mendelevium[112].

Born in Siberia, Mendeleev is known to have been part of a large family, though sources differ on exactly how many siblings he had (almost all cite above ten[i]). He grew up in relative poverty and, after his father's death in 1855, joined the Gymnasium in Tobolsk. He eventually attended St. Petersburg University, where he would return to teach in 1865. Three years later, he began his seminal work in assembling the elements into what would become the periodic table. While other scientists had noted periodicity in the elements, none had yet published their work in a particularly convincing or organized manner. After studying the phenomenon, Mendeleev claimed the table appeared to him in a dream[113], and he published it in his book, *The Principles of Chemistry* in 1868. After an illustrious career, he retired from his position in 1890.

Mendeleev was one of the most respected scientists of his era, both in and outside of Russia. He was elected to the Royal Swedish Academy of Sciences, the French government declared him a member of the Legion of Honor, and he received both the Davy and Copley Medals from the Royal Society of London. Despite this international respect, Mendeleev was never admitted into the Academy of Sciences in his home of Russia because his second marriage was deemed unlawful by the Russian Orthodox Church[113].

**Spelled Mendelejeff (an outmoded spelling) on the pavilion face*



6.12 - Perkin

William Henry Perkin (1838-1907) was an English chemist famous for his discovery of purple mauveine dye when he was only eighteen years old.

Born in London, Perkin developed his passion for chemistry at the City of London School before attending the Royal College of Chemistry at the age of fifteen. Studying under August Wilhelm von Hofmann, Perkin, then an assistant, accidentally produced a dye from aniline while attempting to synthesize quinine. Perkin kept his discovery secret from Hofmann, filing a patent in 1856 after some further testing[114]. Perkin worked to grow his dye business, and he gained significant wealth from his discovery, in part because purple dye was, at the time, very rare (the only other existing dye of a similar hue was painstakingly extracted from mollusks[115]). Having earned a comfortable living from mauveine, Perkin retired at the age of thirty-five and spent the rest of his life studying organic chemistry at his leisure, though he specialized in the manufacture of dyes. He saw two of his three sons become of professors of chemistry before dying of appendicitis in 1907[114].

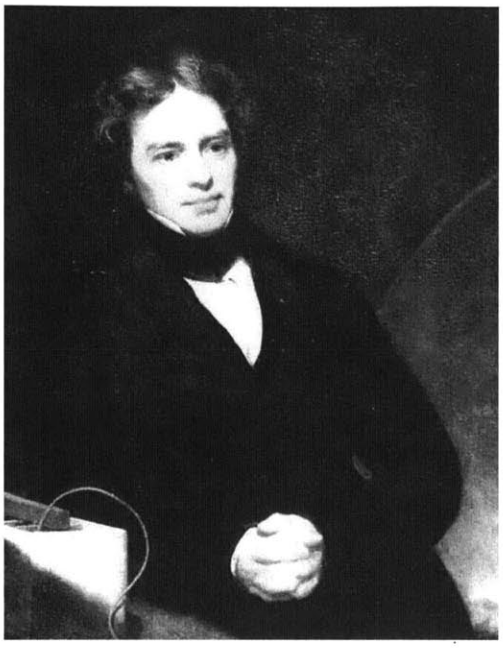
In his choice of name for his dye, Perkin brought the word "mauve" itself from relative obscurity into prominence. Unfortunately, because Perkin's original dye was quick to fade, the modern understanding of the color mauve is a dull, greyish purple, rather than the vibrant color its creator intended[116].

6. 13 - van't Hoff

Jacobus Henricus van't Hoff (1852-1911) was a Dutch chemist known for his work in chemical kinetics and his studies of chemical equilibrium. He was the first to win a Nobel Prize in chemistry, and the van't Hoff equation is still widely used in chemical thermodynamics.

Born in Rotterdam, van't Hoff exhibited a love of science from a young age. After he completed his lower-level education, he had already determined that his course in life was to become a chemist, but his parents pushed him to take a broader course of study, and he enrolled in the Polytechnic School at Delft, where he was also introduced to aspects of mathematics and philosophy. Van't Hoff matriculated to the University of Leiden in 1871 where he studied mathematics for two years before passing the doctoral examination for chemistry at the University of Utrecht. After a series of successful publications, he became a professor of chemistry at the University of Amsterdam in 1877 and was appointed Department Head within a year. There, he published some of his most influential work, but it wasn't until he moved to the University of Leipzig that a lack of outside responsibilities allowed him to solidify his reputation as one of the best research chemists of his era. After an illustrious career, van't Hoff died in 1911[117].

Building 3, Eastern Face
Electrical Engineers



7.1 - Faraday

Michael Faraday (1791-1867) was an English physicist and chemist known for his work on electromagnetism. He is most famous for his law of induction and the discovery of electrolysis. The SI unit for capacitance was named the "Farad" in his honor.

Born into a poor family on the outskirts of London, Faraday received almost no formal education. He apprenticed himself to a bookbinder at the age of fourteen, a job that allowed him to not only engage in his learning relentlessly but also to develop the manual dexterity that would facilitate the characteristic precision of his later experiments. Though Faraday was beginning to associate with other scientifically minded individuals, he may never have come to such preeminence in the scientific world were it not for the generosity of one of his book customers, who gifted him a ticket to Humphry Davy's chemistry lectures at the Royal Institution in early 1812. Months later, when Davy temporarily lost his eyesight in a chemical explosion, he took up Faraday as a secretary, later electing to fully employ him as an assistant[118]. Over the next ten years, Faraday built his reputation as an analytical chemist, eventually discovering benzene in 1825. Though his researches in electricity took a backseat to his work in chemistry during this time, he nonetheless maintained his interest, publishing his discovery of electromagnetic induction in 1831. Faraday then shifted his focus more concretely to issues surrounding electricity, and he continued to develop insights into magnetic theory and electrical current before his gradual retirement in the mid-1850's.

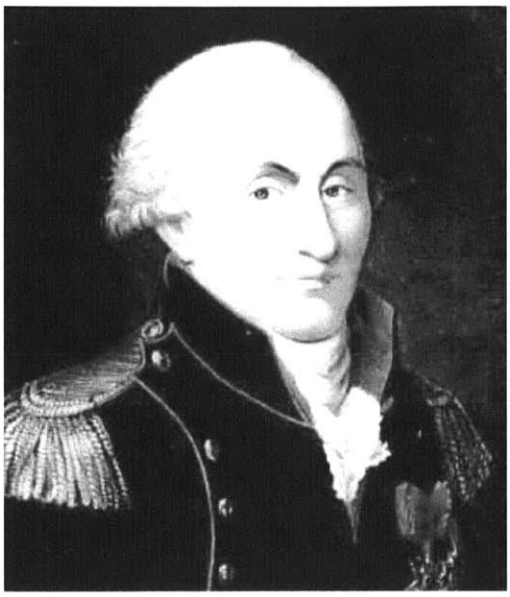
Though all of Faraday's achievements came in spite of an unassuming background, he never faced difficulties with his impecunious upbringing until he met Davy's wife while on an excursion with his mentor in 1813. She harassed Faraday because of his low social status, treating him as a substandard class of human. Her cruelty nearly drove Faraday to abandon science altogether, but Davy was able to placate him[119].

7.2 - Gilbert

William Gilbert (1544-1603) was an English natural philosopher who was one the first in the world to ever work with electricity and magnetism. He is sometimes credited as the one who coined the term "electricity", and the unit for magnetic potential is named in his honor.

Though scientific historians cite Colchester as Gilbert's place of birth, nothing is known about his early life. In 1560, he attended St. John's College, Cambridge, where he received his A.B., M.A., and M.D. over the next nine years. He eventually settled in London in the mid 1570's, where he became one of the city's most prominent physicians. Gilbert began to associate with English nobility, and in 1600 he was appointed physician to Elizabeth I (he would also serve James I after her death). Around the same time, he published his famous text, *De magnete, magneticisque corporibus, et de magno magnete tellure; physiologia nova, plurimis & argumentis, & experimentis demonstrata*, which attempted to explain magnetic phenomena. It would be his only published work in his lifetime[120].

After his death in 1603, Gilbert's half-brother assembled what remained of his writings into another volume, *De Mundo,* which saw relatively little success compared to *De Magnete*. Even then, it took almost fifty years for the book to be published, when it was printed in Amsterdam in 1651. The Great Fire of London would later destroy all of Gilbert's remaining work in 1666[121].



7.3 - Coulomb

Charles-Augustin de Coulomb (1736-1806) was a French physicist most famous for his law of electromagnetic attraction. The SI unit for electric charge bears his name.

Born in Angoulême, at a young age Coulomb moved with his family to Paris, where he would receive his early education at the Collège Mazarin before matriculating to the École royale du génie de Mézières in 1758. Upon his graduation, Coulomb found work as a civil engineer, work in public service when he could[122]. After twenty years of constant travel, he was able to settle down with an election to the Academy in Paris. He began to focus on pure research, and in 1785 he produced his first three reports on electricity and magnetism, upon which he would expand later in the decade. Unlike many of his contemporaries, Coulomb was able to carry out his work uninterrupted during the French Revolution, the only major hiccup in his career occurring when he was removed from a committee for the standardization of weights and measures in 1793[123]. After building a prolific reputation as an electrical, civil, and geotechnical engineer, Coulomb died in 1806.

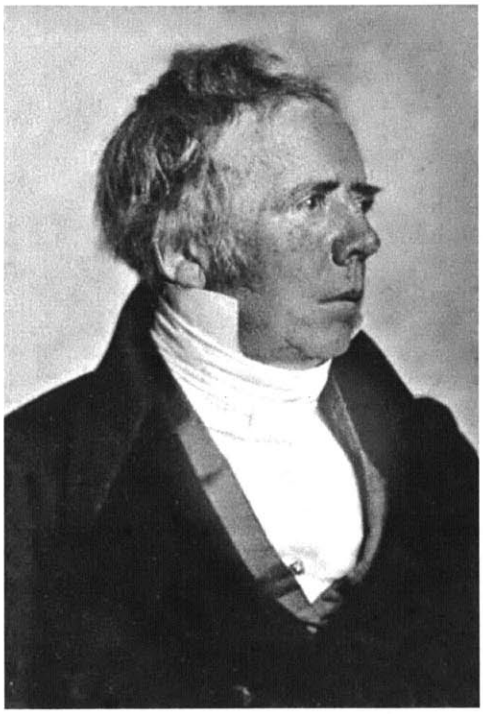
Though he is most often celebrated as for his work with electricity and magnetism, Coulomb produced equally significant work in solid mechanics. He was among the first to develop beam theory, and many of his equations for cantilevers are still used today. Most notable was his work in friction, in which he expanded on the ideas of Guillaume Amontons, showing that the relationship between friction and normal force is approximately linear. It would not be an exaggeration to say that Coulomb effectively created the science of friction[122].

7.4 - Volta

Alessandro Volta (1745-1827) was an Italian physicist known for his work with static electricity and capacitance, as well as the discovery of methane. He invented the modern electrochemical battery, and the "Volt" is derived from his name.

Born in Como, Volta was raised by his uncle after his father's death when he was seven. He was educated at the local Jesuit college, and at the age of eighteen began his own independent study of electricity, often writing to Cesare Beccaria, one of the prominent electrical scientists at the time. Throughout his early twenties, Volta worked in a makeshift home laboratory, where he regularly had to invent his own equipment. In addition to his work on electricity, he took up the study of the chemistry of gases in his thirties, eventually isolating methane gas. Not too long afterward, he was granted a position as professor of experimental physics at the University of Pavia, where he remained for the rest of his life[124].

An Italian 10,000 lira note depicting Volta and his first battery design



7.5 - Oersted

Hans Christian Oersted (1777-1851) was a Danish physicist and chemist famous for his discovery of the relationship between electric current and magnetic field. He is also known for his research on the compressibility of gases and liquids.

Born in the town of Rudkøbing to a large family, Oersted and his brother, Anders Sandøe, were raised by friends of the family until the age of eleven, at which point his mental abilities earned him an apprenticeship in his father's pharmacy. Though neither brother received any formal education, both were able to enroll in the University of Copenhagen in 1794. There, the two parted ways (Anders eventually became the Danish prime minister), and Oersted directed his course of study to natural science, though he developed a special predilection for the philosophy of Immanuel Kant. He briefly served as an editor for a periodical promoting Kantian philosophy, and, more importantly, he developed philosophical views which he would maintain in both his doctoral thesis and for the rest of his life. After receiving a grant to visit Berlin, Göttingen, and Weimar, Oersted returned to Copenhagen in 1804, where a series of public lectures brought him both fame and a professorship at his alma mater after two years. Over the next two decades, Oersted would not only work diligently as a researcher, but he would also grow Denmark's scientific infrastructure as a whole. He deeply invested himself in the popularization of science, often publishing in journals commonly read among Danish intellectuals, and in 1824, he founded the Society for the Promotion of Natural Science. Five years later, he was elected to the position of director of the Polytechnic Institute in Copenhagen, a position he would hold until his death in 1851[125].

Oersted's most famous finding, the discovery of the electromagnetic effect in 1920, was actually first performed in front of an audience. Well known as a fantastic teacher, he had prepared his initial experiment for a lecture, but equipment issues prohibited him from testing the apparatus beforehand. Standing before a full lecture hall, Oersted had no idea whether his

compass needle would turn when he flipped the switch to apply an electrical current near it. As it was, the compass needle barely moved, and the audience was generally unimpressed by the phenomenon[126].

7.6 - Ampère

André-Marie Ampère (1775-1836) was a French physicist famous for his studies of electromagnetism. The SI unit for electrical current bears his name.

Though Ampère was born in Lyons, his family moved to the nearby village of Poleymieux shortly after his birth. His early learning, per his father's philosophical leanings, was based on the ideas laid down by Jean-Jacques Rousseau and took the form of Ampère's self-education in his father's library. As a youth, he quickly took to the natural sciences, learning grammar and Latin only as a means to further his reading in his areas of interest. In 1793, his father lost his life to the guillotine in the French Revolution, an event from which Ampère would not emotionally recover until his marriage six years later[127]. He lived in relative happiness as a mathematics teacher in Lyons until his wife's death in 1803, which prompted the distraught Ampère to abandon his home for a position at the École Polytechnique in Paris. There, his abilities brought him increasing success and eventually his first professorship in the field of astronomy. In 1820, François Arago told Ampère of Hans Christian Oersted's discovery of the electromagnetic effect, prompting a flurry of research that culminated in his 1827 treatise *Mémoire sur la théorie mathématique des phénomènes électrodynamiques uniquement déduite de l'experience* (Memoir on the Mathematical Theory of Electrodynamic Phenomena, Uniquely Deduced from Experience), which effectively established the study of electromagnetism as a science[127].

Unfortunately, for all of his scientific success, Ampère often suffered in his personal life. He was, in many ways, a hopeless romantic, and after his first wife's death in 1803, he rushed into a loveless marriage in which his new wife and mother-in-law berated him endlessly. After his father-in-law withheld Ampère's patrimony, he finally divorced, living the rest of his life in financial turmoil before his death in 1836. In his final act, he wrote his own epitaph: *Tandem felix*, or "Happy at last"[128].

7.7 - Ohm

Georg Ohm (1789-1854) was a German physicist famous for his law relating current to voltage. The SI unit for resistance is named in his honor.

Born in the Bavarian city of Erlangen, Ohm was the son of a self-educated locksmith who took a heavy interest in his two sons' education in the sciences. With the help of his father's tutoring, Ohm was granted entrance into the University of Erlangen in 1805, eventually receiving his PhD in 1811. After a brief stint on the faculty at his alma mater, displeasure with his potential for advancement inspired him to seek work elsewhere. A long job search ended when the Bavarian government granted him a position as a mathematics teacher in the German school system, and he continued to teach lower-level mathematics until 1825, when his independent research in electromagnetism prompted him to take a leave of absence. He published his findings, including his famous law, two years later, but the significance of his discovery was not recognized over a decade[129]. During this time, Ohm struggled to find work, eventually landing a professorship of physics at the Polytechnische Schule in Nuremberg, a post he was not excited to accept. Ohm died in 1854, generally renowned for his accomplishments.

The story of Ohm's eventual success is one of quiet desperation. Accounts of the man in his early college years describe him as a youthful free spirit, and his father even removed him from Erlangen for two years after he learned of his son's growing affinity for leisure activities such as dancing, billiards, and ice skating[129]. After he left with his degree, years of unsteady work seem to have beaten Ohm's blithe personality into submission, and his decision to publish his independent research was truly a desperate attempt to escape his career, borne on his fatigue as a teacher and the realization that he would never marry. Even after his publication in 1927, Ohm's poor luck continued, as controversy associated with his brother's liberal political views kept his work suppressed for more than ten years[130].

7.8 - Henry

Joseph Henry (1797-1878) was an American physicist famous for his law of inductance in electromagnetism. The SI unit for inductance bears his name.

Born to a poor family in Albany, New York, Henry spent most of his early years with relatives in the nearby town of Galway. As a teenager, he was apprenticed to a watchmaker and a silversmith while learning at the Albany Academy. To support himself, Henry worked as a surveyor, and his experiences undoubtedly influenced his future endeavors as an engineer and professor of mathematics and natural philosophy at the Academy, where he began to experiment with magnetism in the late 1820's. Henry quickly took to building electromagnets, and by the end of the decade, he had created the strongest in the world. Through his work with motive devices, he developed his law of inductance in 1831, and he was granted a professorship at the College of New Jersey (later to become Princeton University) a year later. For the next five years, Henry's teaching duties distracted him from his research, but a fortuitous introduction in London to Michael Faraday (who had independently discovered self-inductance around the same time as Henry) in 1837 inspired Henry to renew his research endeavors. In 1846, he was appointed as secretary of the Smithsonian Institution, and his work once again halted. He held the position until his death in 1878[131].

Though Henry was familiar with the work of all the major players in the burgeoning science of electromagnetism, he most preferred to associate himself with Benjamin Franklin. While at Princeton, he even went as far as to use the pseudonym "F", to honor his fellow American scientist[132]. While Franklin served as a foreign emissary, however, it was often Henry's duty as secretary of the Smithsonian Institute to act as a scientific ambassador to his fellow electrical engineers. Indeed, Henry consulted with both Samuel Morse before the advent

of the latter's telegraph technology and Alexander Graham Bell before the invention of the telephone[131].

7.9 - Maxwell

James Clerk Maxwell (1831-1879) was a Scottish physicist and mathematician famous for his set of equations that describe electricity and magnetism. He is also known for working with Ludwig Boltzmann to develop a kinetic theory of gases.

Born in Edinburgh, Maxwell showed promise from a young age, and he was placed in the Edinburgh Academy and later matriculated to the University of Edinburgh, where he graduated in 1854. By this time, he had already published four papers on geometry, producing the first when he was only fourteen years old. He had also begun his lifelong interest in quantitative colorimetry, a study that would develop into a lifelong pursuit, the crowning achievement of which would be the first trichromatic color photograph (presented at the Royal Institution to, among others, Michael Faraday[133]). Maxwell continued his research while holding professorships at the University of Cambridge and Marschal College, Aberdeen, and King's College in London, where he published much of his work on electromagnetism and developed the engineering practice of dimensional analysis. In 1865, Maxwell retired from academics and began to write his famous *Treatise on Electricity and Magnetism*. He died of abdominal cancer in 1879, six years after its publication.

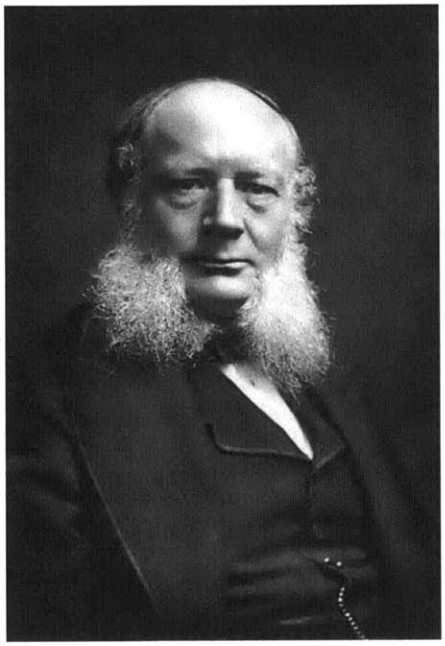
It has taken twentieth-century physics to bring the true importance of Maxwell's ideas to light, but even at the time of his selection for Maclaurin's list, the MIT president had personal experience with the far-reaching impact of Maxwell's work. In 1871, Maxwell was appointed the first professor of experimental physics at Cambridge University. There, he was solely in charge of the development of the new Cavendish Laboratory, a laboratory at which Maclaurin would study thirty years later[134].

7.10 - Morse

Samuel Morse (1791-1872) was an American inventor responsible for the invention and commercial use of a popular electric telegraph design. He also developed the system used to relay messages on his machines, and Morse Code still sees use today.

Born in Charlestown, Massachusetts, to a Calvinist family, Morse attended Phillips Academy before matriculating to Yale College, where he studied religious philosophy and mathematics. After his graduation in 1810, he sought to make a career of his lifelong passion for painting, and he soon moved to London to join the Royal Academy in an attempt to perfect his craft. He returned to the United States after three years, where he met moderate success as a painter. In 1825, while in Washington, DC to paint a portrait, Morse received a letter from a messenger on horseback that his wife, then in New Haven, was deathly ill. Morse abandoned his portrait to immediately return home, but, by the time he arrived, she had already been buried[135]. He was thus inspired to develop a means of instant, long-range communication, and he began to develop his single-wire telegraph design, and its accompanying code, in 1832. The first public demonstration of his invention took place in 1838.

It took Morse until 1847 to receive a patent for his design, mostly due to intense competition and difficulties with relays over long distances. William Cooke and Charles Wheatstone had developed their own multi-line telegraph, though the pair eventually lost out to Morse's simpler (and less expensive) design[136].



7.11 - Siemens

Charles William Siemens* (1823-1883) was an engineer famous for the Siemens-Martin process of steel production. Though originally German, Siemens became a British subject during his lifetime, and his process would come to replace that of his fellow countryman, Sir Henry Bessemer.

Born in the town of Lenthe, Siemens was educated in the German school system before matriculating to the Universty of Göttingen, though he never completed his education. He instead took an apprenticeship in manufacturing at the age of twenty, and, when financial trouble began to threaten his family, he moved to London to find work implementing an electroplating process invented by his brother, Werner. In his twenties, Siemens was a somewhat unsuccessful inventor, experimenting with various steam engine technologies that never quite panned out. He sustained himself by marketing his brother's inventions in telegraphy until he was able to finally break through with a device for measuring water consumption. After being naturalized as a British subject in 1859, he began to develop a regenerative gas furnace, and when French engineer Pierre-Émile Martin adapted the technology for open-hearth steel making, the two, and their new Siemens-Martin process, gained relative fame. With his financial future secured, Siemens toned back his rampant desire to innovate for more leisurely projects. He spent the later parts of his life promoting the reduction of air pollution and the conservation of fuel in scientific circles before his passing in 1883[137].

Among so many electrical engineers and physicists on the face of his pavilion, Siemens seems to stand out. Why was his name not placed next to the likes of Henry Bessemer? The answer, it seems, lies in some of Siemens's later work in telegraphy. In 1874, over twenty years after he first attempted to sell his brother's telegraph equipment in England, Siemens designed a ship to lay cables across the Atlantic Ocean. The ship's name: *Faraday*[137].

*Name anglicized from Carl Wilhelm Siemens

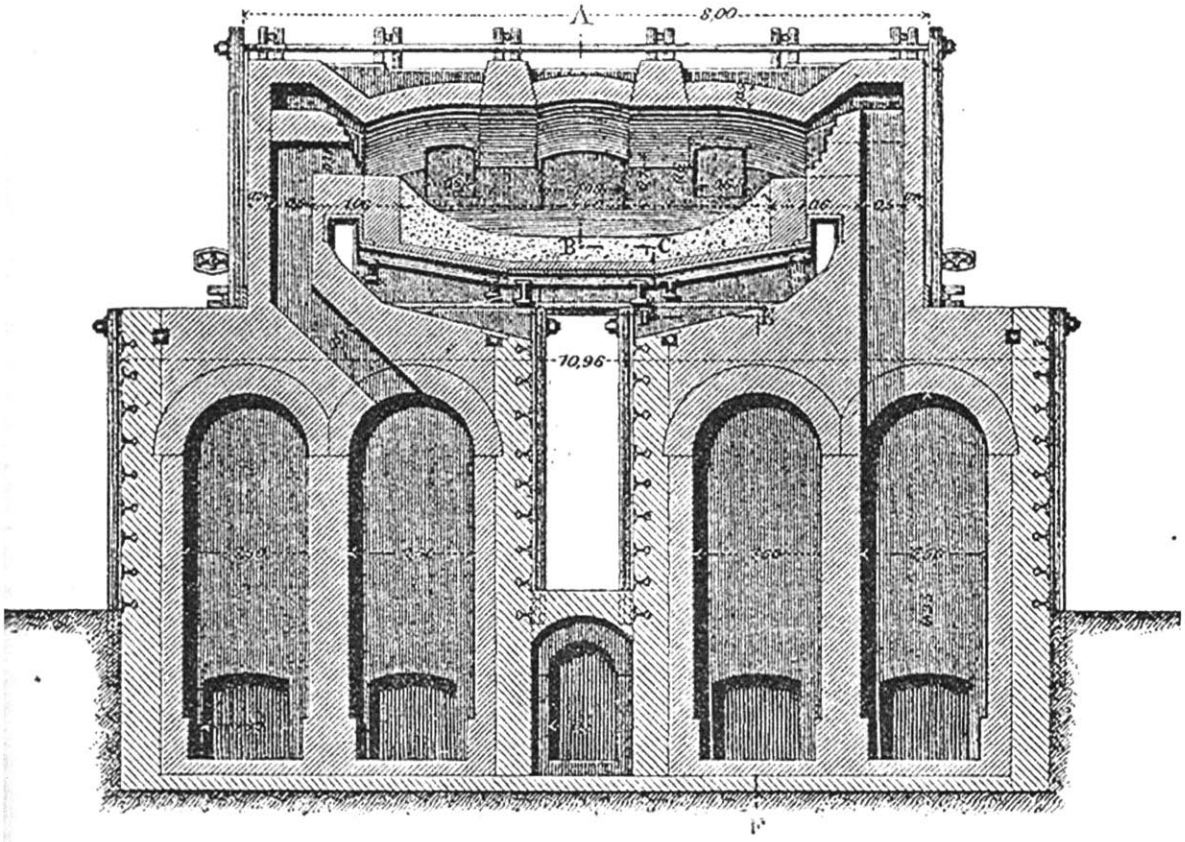


Fig. 295. — Four Martin de 15 t., échelle de 1/120. (Coupe longitudinale.)

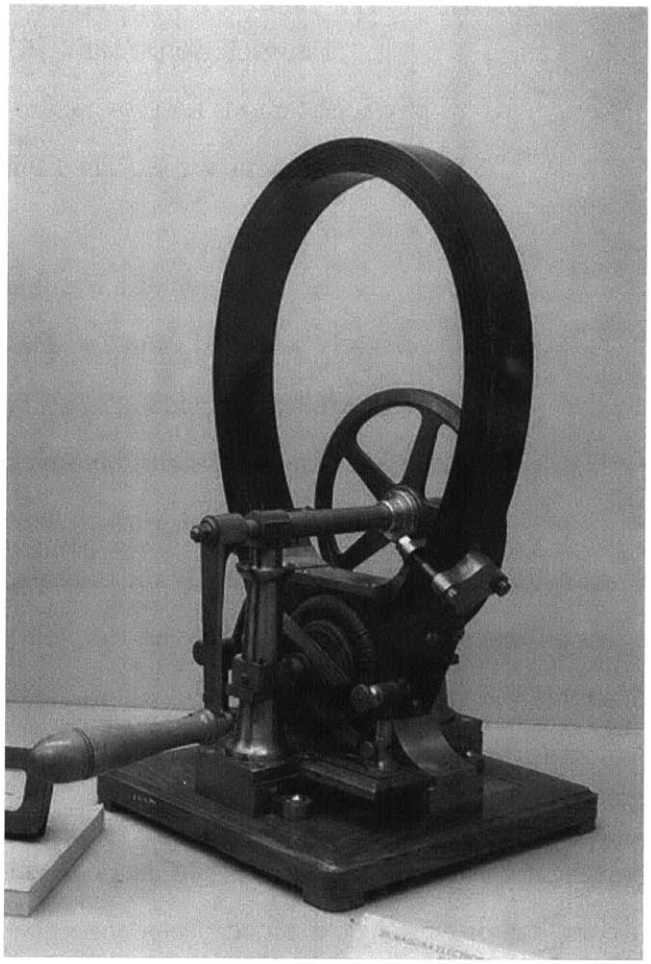
Early picture of a Siemens furnace ca. 1895

7.12 - Gramme

Zénobe Théophile Gramme (1827-1901) was a Belgian electrical engineer famous for his Gramme machine, the first direct current electrical generator to see industrial use.

Born to a middle-class family in Jehay-Bodegnée, Gramme received little education and was an average student. He worked as a carpenter until the age of twenty-six before moving to Paris to specialize as a banister maker. With him, Gramme took his new wife, but a lack of work forced him to seek a job with a firm that manufactured electrical equipment. After around ten years at the firm, he began to experiment with different designs for electrical devices, eventually developing interest in creating a direct current source that did not require the use of a battery. In 1869, he improved the design of Antonio Pacinotti's electric dynamo and quickly acquired a manufacturing partner in French engineer Hippolyte Fontaine. The new Gramme machine found use in metallurgy and other manufacturing applications, but its most impressive quality, Gramme was quick to notice, was its potential to be converted into a direct-current motor. Over the next thirty years of his life, Gramme developed technologies adjacent to his invention, achieving, among other things, the long-distance transmission of direct current[138].

After Gramme's first wife died in 1890, he remarried a young woman named Antonie Schentur, who published some of her late husband's notes in 1901 after his death. Unfortunately, her publishings now serve as evidence of Gramme's fundamental lack of understanding of his own invention. Having never received much of a formal education, he was semiliterate, untrained in advanced mathematics, and completely ignorant of any of the underlying principles governing electromagnetism. Nonetheless, his invention was of critical importance to the advancement of modern electrical technology[139].



A Gramme machine

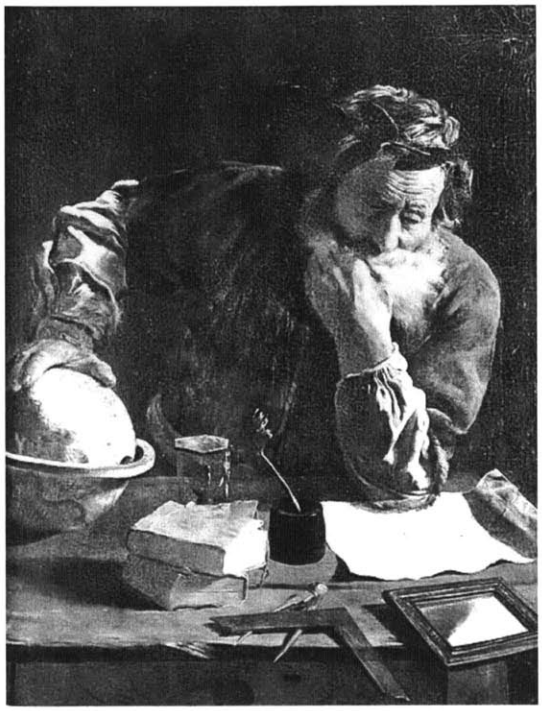
7.13 - Hertz

Heinrich Hertz (1857-1894) was a German physicist famous for proving the existence of electromagnetic waves. The SI unit for frequency now bears his name.

Born the son of a Hamburger senator, Hertz was privately schooled from a young age. At the age of eighteen, he traveled Germany gaining practical engineering experience before eventually matriculating to the University of Munich to study mathematics. His time at Munich, however, was short lived, and Hertz quickly found himself at the University of Berlin in 1878, where he was able to study under Hermann von Helmholtz and Gustav Kirchoff. After he had earned his PhD in 1880, he remained at Berlin to continue his research under Helmholtz before pursuing a position at the University of Kiel. After two years, he abdicated his position at Kiel to Max Planck for another at the University of Karlsruhe, whose better facilities yielded Hertz's most important experimental results. In 1886, he began to delve into Maxwell's theories and, within two years, had proven the existence of electromagnetic radiation. After he published his results, Hertz fielded a great number of offers from institutions seeking to lure him away from Karlsruhe, and he eventually chose a position at the University of Bonn that would maximize his time allocated to research. Unfortunately, within a couple of years of moving to Bonn, Hertz began to suffer from a malignant bone condition, and he eventually died of blood poisoning on New Year's Day in 1894[140].

Hertz is unique among 19th century German scientists in that he is perhaps the only to suffer from Nazi persecution. While Hertz did not identify with the Jewish religion, his father's side of the family was of Jewish descent, and, when the Nazis came to power, Hertz's portrait was removed from Hamburg's City hall. His first and only assistant at Bonn, Philipp Lenard, would come to adopt the Nazi ideology, but, after winning a prize in the cathode ray tube research he had begun with Hertz, was forced to concede that his mentor did have, as he put it, "Jewish blood"[141].

Building 3, Northern Face
Inventors



8.1 - Archimedes

Archimedes of Syracuse (287-212 BC) was a Greek physicist, mathematician, and engineer known for his ability to design machines. He is also cited as one of the greatest mathematicians in all of antiquity[142].

While few details about the life of Archimedes are known, his accomplishments are well documented. His numerous advances in mathematics include a highly accurate prediction of pi, and his use of infinitesimals is a strikingly similar to the manner employed by modern calculus. His most famous invention is the water screw that bears his name, but he was also known for his clever application of leverage, especially in his creation of siege weaponry. Generally considered the most prolific inventor in all of antiquity, he is also credited with, among other things, the invention of the odometer[143].

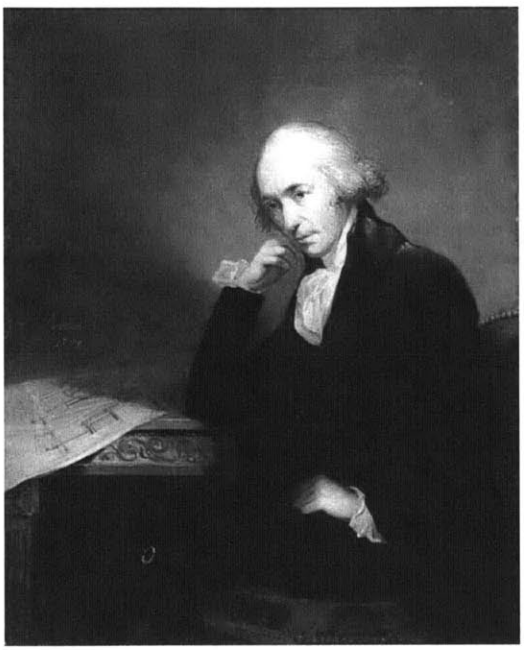
Such was Archimedes's reputation through the ages that it's impossible to tell where the truth ends and the myths about him begin. It is storied that, upon discovering his buoyancy principle in the bathtub, he took to the Athenian streets shouting Eureka ("I have found it!"), forgetting to clothe himself in excitement. Legends of his inventions of war claim he used mirrors to focus sunlight on ships to set them ablaze. Even in his death, it is told that he was killed by a Roman soldier because he was too involved with a math problem to surrender to capture. While these and other dubious claims have been used to describe him, there can be no doubt that Archimedes's reputation was based on the life of a true genius.

8.2 - Gutenberg

Johannes Gutenberg (1395-1468) was a German smith famous for inventing the printing press. His creation is perhaps single-handedly responsible for bringing Europe out of the dark ages.

Born in Mainz, Gutenberg enjoyed childhood as part of an upper-class German family. Though very few specifics remain about his life, it is known that he was trained as a goldsmith, a profession that undoubtedly leant itself to his eventual world-changing invention. Political unrest moved Gutenberg to Strasbourg in 1411, at which point he may have studied at the University of Erfurt. It is believed he began developing his press around 1439, and he shared his early model with the world in 1440. Within a decade, he was operating a fully functional press, and in 1455, he published around 180 copies of the Bible, the first full book ever created with this method[144]. In 1462, a religious conflict forced Gutenberg into exile. Since his death in 1468, his grave has been lost[145].

Despite the wondrous nature of his invention, Gutenberg found himself in considerable debt before his exile. In order to begin his printing operation, he took out a sizeable loan from lender Johann Fust and his son-in-law, Peter Schöffer. As Gutenberg's expenses increased, his debt mounted, and what had begun as a loan of 800 guilders swelled to over 20,000. Fust was eventually granted control of the Gutenberg printing press, leaving its inventor bankrupt[144].



8.3 - Watt

James Watt (1735-1819) was a Scottish mechanical engineer known for his research in the area of steam technology. He is most famous for the unit of power that now bears his name.

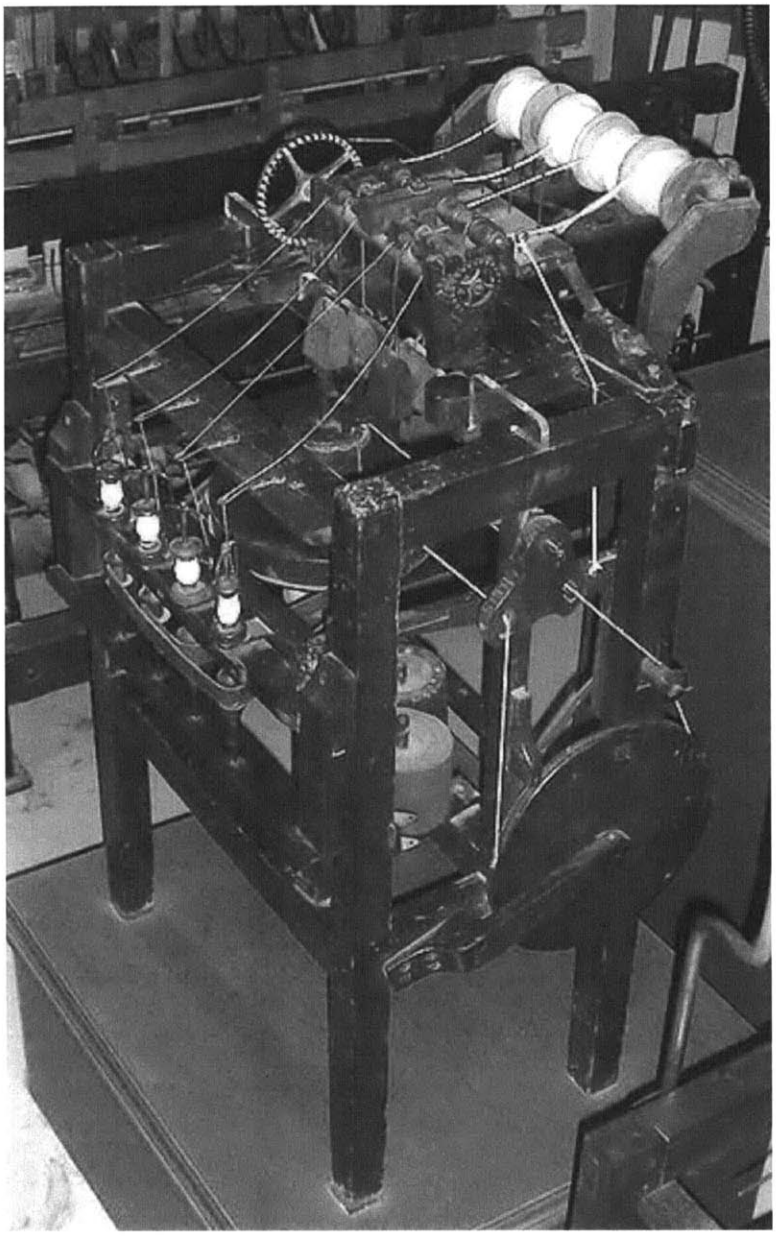
Born in Renfrewshire, Watt came from an educated family. He was a sickly child, and as a result, he was primarily schooled at home. He showed great skill as a craftsman from a young age, and, upon his mother's death when he was eighteen, he moved to London to study instrument-making. After a year, he sought to start his own instrumentation business in Glasgow, but he was denied by the Glasgow Guild of Hammermen due to his lack of experience. He was able to circumvent the ruling by becoming the "mathematical instrument maker" for the University of Glasgow, a title that allowed his relationship with the field of engineering to blossom. Over the course of his career, Watt filed numerous patents, mostly for designs relating to steam engines (including the well-known Newcomen-Watt engine), but also including a perspective drawing machine and a pH indicator liquid, indicative of his lifelong interest in chemistry. Watt eventually retired in 1800[146].

Despite the metric unit that bears his name, Watt was actually responsible for the proliferation of the term 'horsepower', which he used to market his steam engines. According to some, Watt developed a value for the unit by designing an experiment in which a pulley would be rigged to allow a horse to lift a weight up a vertical well shaft, letting Watt gauge the power output. Unfortunately, the story goes, Watt didn't have any horses available, so he was forced to use a pony, which he then estimated at two-thirds the output of a horse. The unit of measurement based on this approximation still sees ubiquitous use today[147].

8.4 - Arkwright

Sir Richard Arkwright (1732-1792) is generally considered the father of the modern industrial factory system. He is famous for inventing the spinning frame for the production of textiles.

Born in Lancashire, England, Arkwright was the youngest of thirteen children to a working-class family. With no money to pay for his schooling, he took up an apprenticeship with a local barber, during which he invented a waterproof dye for wigs. While he was away from work, Arkwright studied the production of textiles, and in 1769, he filed a patent for the spinning frame. He improved his technology by altering its power source, first with a horse, and later using water currents, then finally steam. He developed a series of mills across England and Scotland, and he was eventually knighted in 1786. He died at the age of fifty-nine[148].



An Arkwright water frame ca. 1775

8.5 - Whitney

Eli Whitney (1765-1825) was an American inventor and farmer famous for his cotton gin.

Born in Westborough, Massachusetts, Whitney grew up during the American revolutionary war, and as a youth he manufactured nails in his father's workshop with decent success. In 1789, he was accepted to Yale, an unusual destination for the son of a farmer. Lacking money upon his graduation, he found work as a tutor in South Carolina before moving to Georgia, where he was inspired to invent his famous cotton gin in 1794[149]. The gin (short for "engine") was a mechanical device to separate seeds from cotton. While his invention made cotton a highly profitable industry in the American south, Whitney himself made no net profit from his invention, losing almost all of his earnings in litigation over patent infringement. Nonetheless, the cotton gin brought him fame, and he signed a contract with the United States government in 1798 as an arms manufacturer. The use of interchangeable parts characterized the design of his muskets, though he far from the first to develop the concept[150]. The profits from Whitney's armory would sustain him until his death in 1825.

Despite the greatness of Whitney's inventions, it is impossible to ignore their negative historical impact. The invention of the cotton gin helped to cement slavery as an institution in Georgia and other states, eventually prompting the American Civil War. To make matters worse, the fact that the war was the bloodiest of American conflicts is due in part to the massive armory of weapons Whitney had supplied to the U.S. government[150]. Though surely unintentional, it might be said that there was no single man more responsible for the American Civil War than Eli Whitney.

8.6 - Fulton

Robert Fulton (1765-1815) was an American engineer known for creating the first commercial steamboat. He also designed the world's first submarine.

Born in Little Britain, Pennsylvania, Fulton spent most of his early life in Philadelphia. In his early twenties, he sought to make a living painting portraits, but, after visiting Europe at the age of twenty-three, he shifted his focus to canal and ship building. His work eventually brought him to Paris in 1793, where he designed the first submarine under the commission of Napoleon Bonaparte[151]. Fulton moved to England in 1804, where he designed ships and torpedoes for the Royal Navy before returning to America two years later. While abroad, he had formed connections to fund further ventures in shipbuilding, allowing him to produce the first commercial steamboat, the *Clermont*, a passenger vessel which travelled between Albany and New York City. From his design, steamboats flourished in the nineteenth century[152]. Having accrued significant wealth from his designs, Fulton died of pneumonia in 1815.

During his time in Paris, Fulton had many opportunities to build relationships with foreign dignitaries and American diplomats. Benjamin Franklin was not one of them. While he was still an artist in Philadelphia, Fulton had the opportunity to paint a portrait of Franklin, and the two knew each other quite well by the time Fulton had made it to Europe[151].

8.7 - Froude

William Froude (1810-1879) was an English engineer and hydrodynamicist who developed laws regarding water resistance for ships. He is best known for the dimensionless group known now as the Froude Number in fluid mechanics and Froude Efficiency in naval engineering.

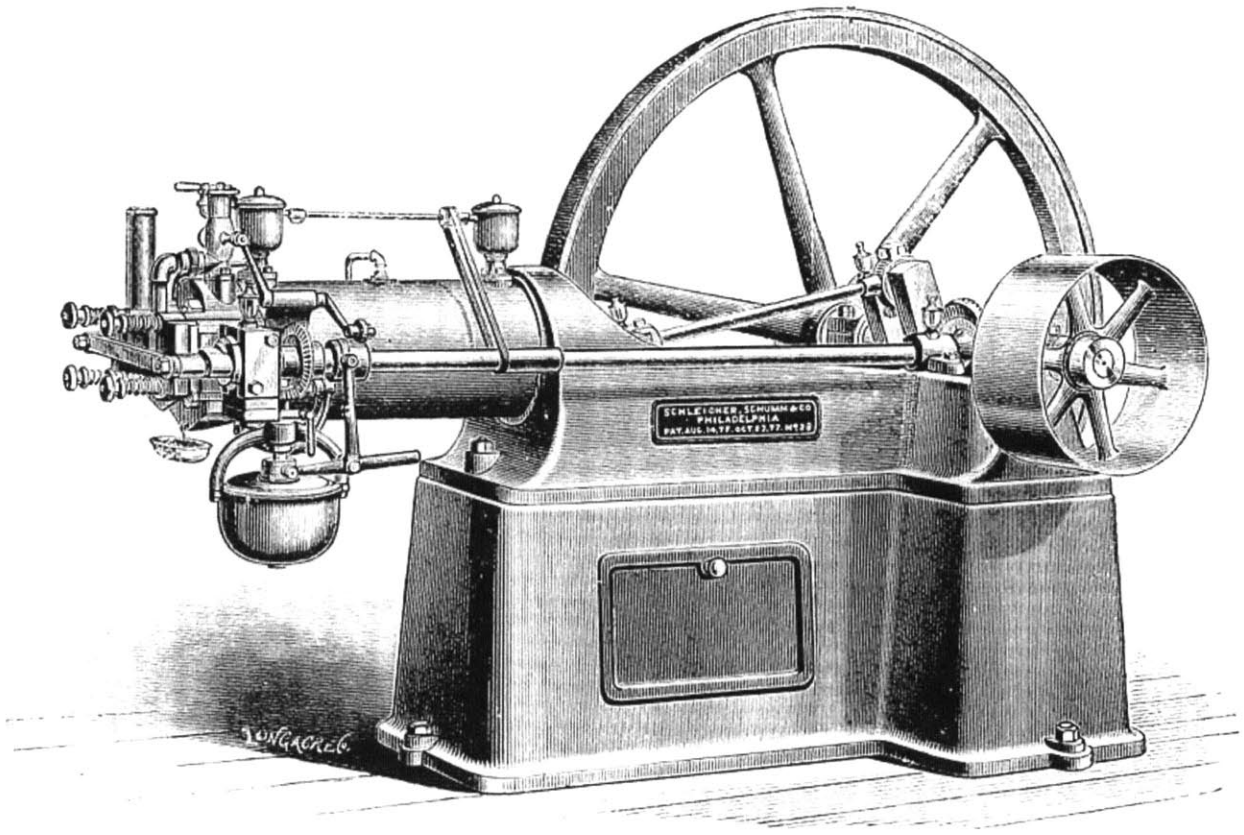
Born in Devon, Froude was educated at Oriel College before attending Oxford University. Upon his graduation in 1832, he began a career as a civil engineer, though he retired young at the age of thirty-six. Froude was an avid yachtsman, and in his retirement, he studied different aspects of ships. His novel use of models led to his development of the Froude number, which allowed him to properly scale his designs. These models led to improvements in naval hull design, and Froude's scaling techniques found significant usage in other varieties of engineering. Froude eventually retired to South Africa, where he died in 1879[153].

8.8 - Otto

Nikolaus Otto (1832-1891) was a German inventor who created the first usable modern internal combustion engine. He is also known for the Otto cycle in thermodynamics which was used to understand the thermal processes that take place during the combustion of his engines.

Born in Holzhausen to a farmer, Otto became a travelling salesman in his youth. He eventually moved to Cologne, where he dabbled in new technology while he began to narrow his business focus to the sugar trade[154]. After seeing Étienne Lenoir's two-stroke engine design, Otto began to tinker with a four-stroke model, but he lacked the true technical expertise to build a proper engine. Through his business, in 1864 he became acquainted with the owner of a sugar factory, Eugen Langen, who also acted as the factory's technician. The two joined in a partnership, forming N.A. Otto and Cie., the world's first engine company. Three years later, they won the Grand Prize at the Paris World Exhibition, and they had produced over 625 engines by 1875. The addition of extra engineers brought improvement to the engine design, and the company built over 30,000 Otto engines[155].

Unfortunately for Otto, production ceased upon the revocation of his patent in 1886, when it was discovered that he was not the first to claim ownership to the idea. The first internal combustion engines were designed by Italian inventors Eugenio Barsanti and Felice Matteucci, who filed a patent in London in 1854. Furthermore, the four-stroke cycle itself was patented by Alphonse Beau de Rochas in Paris in 1862. Nonetheless, Otto is still honored in name by the thermodynamic cycle that describes the four-stroke process[154].



A Stationary Otto Internal Combustion Engine ca. 1920

8.9 – de Laval

Gustaf de Laval (1845-1913) was a Swedish engineer known for his contributions to the development of steam turbines. His nozzle design for supersonic gas flow is still used today in modern rocket engines.

Born in Dalarna, de Laval exhibited a lifelong interest in engineering, eventually enrolling in the Institute of Technology in Stockholm in 1863. After his graduation in 1866, he continued his studies at Uppsala University for a year before joining Stora Kopparberg, a Swedish mining company. In 1872, he returned to Uppsala to receive his doctorate, setting the stage for him to become one of Sweden's most successful engineers. In the latter half of the decade, he began to develop a steam turbine engine, which he would continue to improve in the 1880's. It was during this time that he also developed the de Laval nozzle, which still sees use today[156]. In an unusual cross-application of his design, de Laval was able to adapt a centrifugal oil/water separator he designed for his engines for use in the dairy industry, filing a patent in 1894. This invention led him to file further patents for the world's first milking machines[157].

Though his contributions to the engineering world were extraordinary, de Laval occupies a special place in the hearts of the world's dairy farmers. In the United States alone, it has been estimated that his centrifugal milk/cream separator design saves farmers $35 million annually. De Laval has even been called, "the Thomas Edison of dairying"[156].

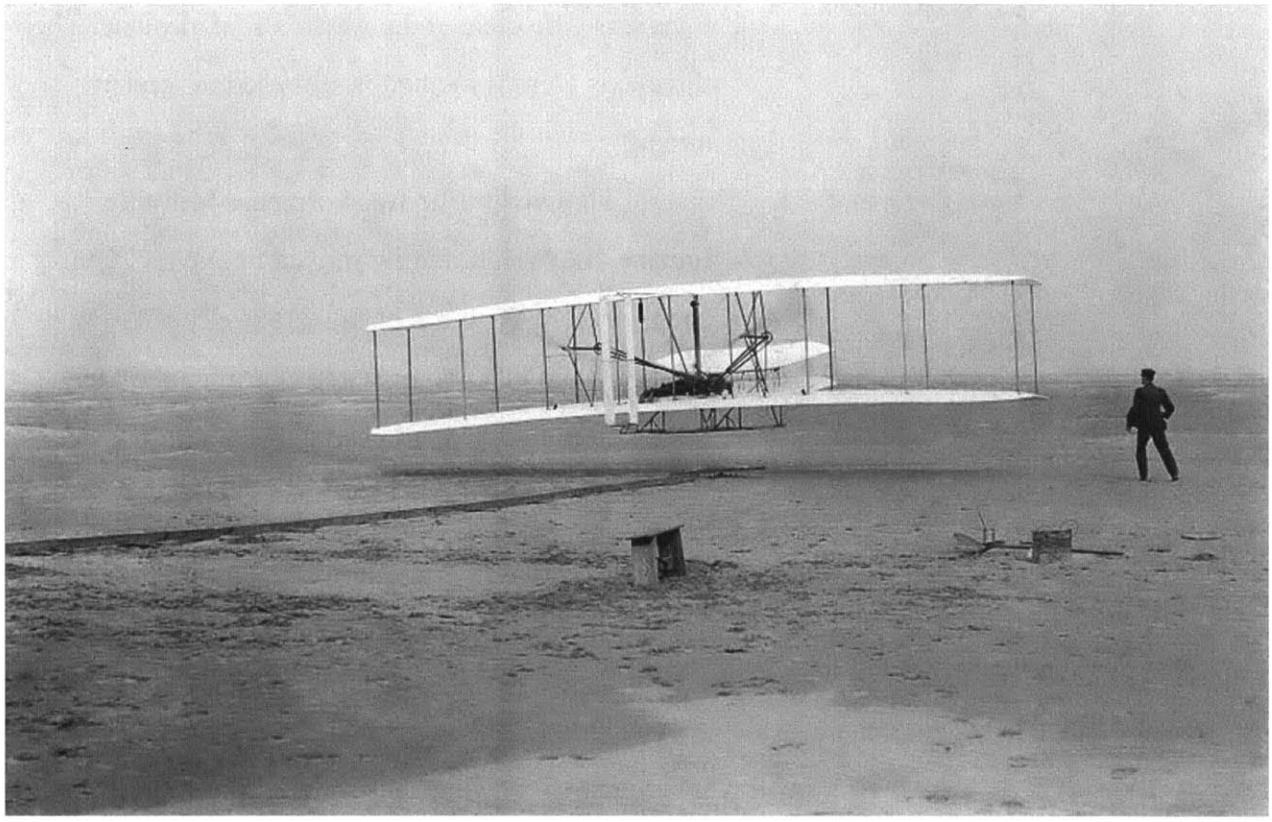
8.10 - Wright

Orville and Wilbur Wright (1867-1912 and 1871-1948, respectively) were two American inventors who created the world's first airplane. Their three-axis control method is still used in modern aircraft.

Though Orville was born near Millville, Indiana, the Wright family moved to Dayton, Ohio shortly before Wilbur's birth in 1871. The Wright brothers were just two of seven children, and their education did not extend past high school. In 1889, Orville founded a printing business, where Wilbur soon joined him. The print shop quickly failed, and the brothers opened a bicycle shop in its place[158]. There, they developed their technical skills, but it wasn't until they heard news of the tragic death of German aviator Otto Lilienthal in 1896 that the two sought to apply their ingenuity to flight[159]. By 1900, they had developed a full size bi-wing glider, which they mainly tested unmanned. As they sought to improve their designs, they built a small wind tunnel to test wing shapes. Within a year, the two were executing manned glides with their quickly evolving steering system. In 1903, the brothers attempted to power their glider, employing the use of an aluminum engine to save weight, and on December 17, they finally met success, flying distances of 120, 175, and 200 feet on their three attempts[160]. The Wright brothers quickly became world-famous, though they met some initial difficulty profiting from their invention due to costs associated with patent litigation[ii]. Nonetheless, the brothers were recognized as national heroes, and after Wilbur's death from typhoid in 1912, Orville was able to move his family into a mansion in Oakwood, Ohio. Orville died in 1948, at which point aviation had grown in ways unimaginable when he had started in his bicycle shop fifty years before.

Storied and disputed as the Wright brothers' legacy is, one of the more surprisingly hostile controversies regarding the beginning of flight is between two American states: Ohio and North Carolina. While the brothers lived their entire lives in Ohio, they performed their flight

tests in Kitty Hawk, North Carolina, generating a dispute as to which state has proper claim to the Wright brothers. To this day, Ohio automotive license plates bear the words, "Birthplace of Aviation," where North Carolina's claim to be "First in Flight."



The world's first airplane, the Wright Flyer I

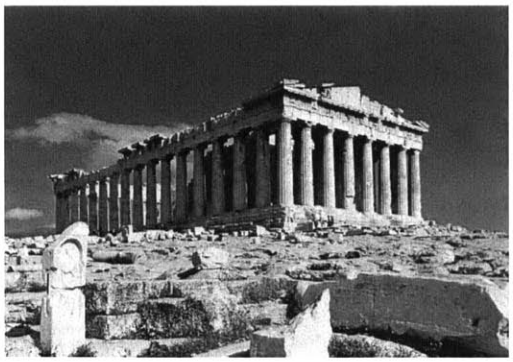
Building 1, Southern Face
Architects

9.1 – da Vinci

Leonardo da Vinci (1452-1519) was an Italian polymath famous for his diverse work in anatomy, engineering, architecture, and the arts, among his other dabblings. His wide-ranging talents characterized the age of the Renaissance, though he is perhaps best known for his paintings, among which is the *Mona Lisa*.

Leonardo was the illegitimate child of a Florentine notary in the town of Vinci in Tuscany[161]. After receiving a rudimentary education, he became an apprentice to the artist Verrocchio in Florence at the age of fourteen. Showing unusual talent from the onset of his apprenticeship, Leonardo began his own workshop, though he continued to collaborate with Verrocchio until his departure to work under the duke of Milan in 1482. For the next seventeen years in Milan, he would cultivate his interests in mathematics, mechanics, and anatomy while perfecting his sculpture and painting, producing such works as his famous *Last Supper*. In 1499, war with the French drove Leonardo back to Florence. Over the years until his death in 1519, war kept him on the move while he found work in military engineering, though he never fully abandoned his other pursuits[162].

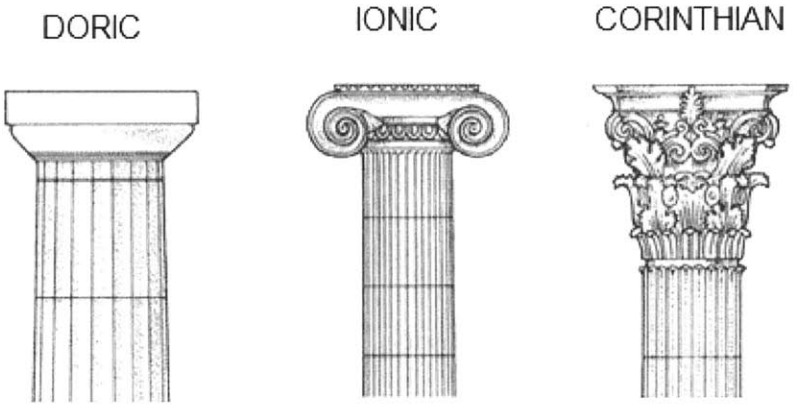
Although Leonardo da Vinci's reputation as an incredible thinker is taken as fact in modernity, scholars have a difficult time measuring his exact scientific contributions. Though it is well-documented that Leonardo wished to produce treatises on painting, architecture, mechanics, and anatomy, only two works were ever published under his name, both of which were produced posthumously from his notes (most of the notes themselves have now been lost)[162]. The turbulent times in Italy during the latter half of Leonardo's life undoubtedly contributed to these losses. In one well known instance, French soldiers used the clay model for his *Gran Cavallo* for target practice. The statue was to be the largest equine bronze of its time[163].



9.2 - Ictinus

Ictinus was a Greek architect who lived around 430 BC. He is credited as one of the architects of the Parthenon in Athens[164].

Though there are no recorded accounts of his life, some information may be gleaned from his architectural works. Ictinus is best known for his use of multiple column styles, including the earliest known use of a Corinthian column in the Temple of Apollo at Bassae, which also included columns of the Doric and Ionic order. The Parthenon, his greatest achievement, is itself generally considered to be the epitome of development of the Doric order. The building took fifteen years to construct and housed some of the finest Greek artwork of the era[164].



Different types of Greek column styles

9.3 - Phidias

Phidias (480-430 BC) was an ancient Greek artist, known as one of the greatest sculptors in all of antiquity. His most famous work was the giant bronze *Athena Promachos*, which stood on the Athenian Acropolis[165].

Today, Phidias's work lives on only in the surviving Roman reproductions of his statues, and accounts of his life are few and far between. His sculpture was nonetheless prolific, and Phidias gained notoriety while he was alive for works such as his statue of Zeus at Olympia, considered one of the seven wonders of the ancient world. According to Plutarch, Phidias died in jail after being sentenced for sculpting his own image into the shield of Athena in the Parthenon[166].

Phidias is honored in the placeholder, φ, for the Golden Ratio. He was known to use the number in his sculptures and other works[165].

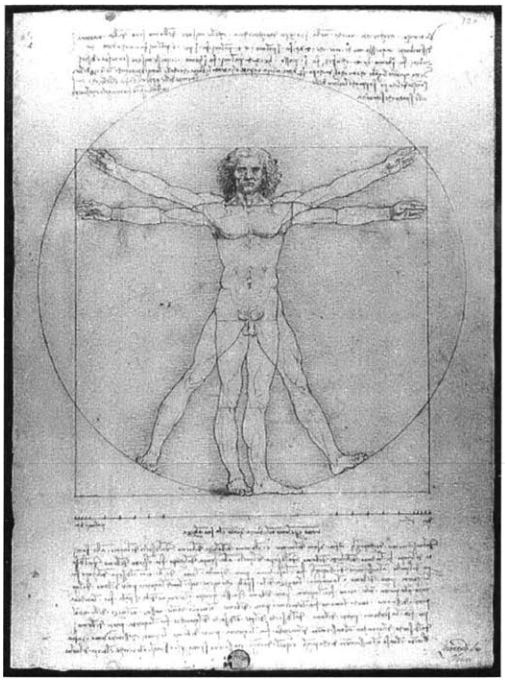
Artist's rendition of the Athena Promachos

9.4 - Vitruvius

Marcus Vitruvius Pollio (1st century BC) was a Roman architect famous for producing *De architectura,* the first known text about architecture[167].

Though little is known about his life, Vitruvius reveals in *De architectura* that he was involved in the military, most likely under Julius Caesar as an engineer. As a civilian, Vitruvius was nominally an architect but practically dealt in civil and mechanical engineering as well[168]. His most famous development lies somewhere between these fields in his placement of primitive bass traps in theaters, earning him the title of "father of architectural acoustics"[168]. Among architects, Vitruvius is known for what is now called the Vitruvian Triad: a stipulation taken from *De architectura* that structures should be solid, useful, and beautiful[167].

Vitruvius lends his name to Leonardo da Vinci's famous sketch, *Vitruvian Man.* Leonardo chose the name because he was inspired by Vitruvius's writing on geometry and human proportions, in which he described a man inscribed in a circle and a square[169]:

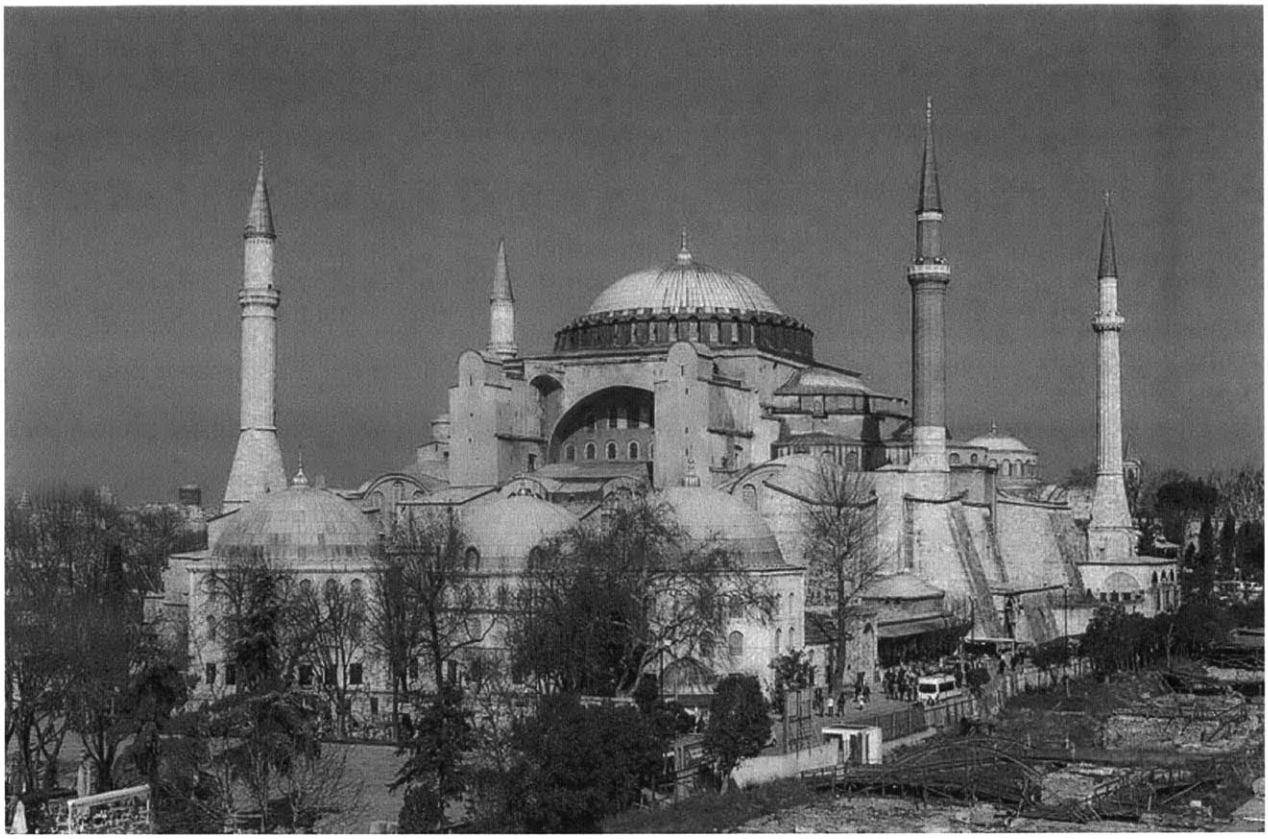


9.5 - Anthemius

Anthemius of Tralles (474-578 AD) was a Greek architect during the reign of Justinian in the Byzantine empire. He is best known for designing and building the Hagia Sophia in Constantinople, though he also was a well-known geometer during his lifetime[170].

Born to a well-educated family, Anthemius was one of five sons, each of whom met relative success in their fields. He became a professor of geometry in Constantinople while also serving as a commissioned architect. In addition to his construction of the Hagia Sophia (completed in collaboration with Isodore of Miletus[171]), Anthemius also demonstrated engineering skill in conducting flood repair in Daras (now a ruin in modern-day Turkey). Anthemius is also known for his work with conic sections in mathematics, about which he produced a book early in his 169

Though anecdotal, there exists some evidence that Anthemius was something of a prankster in his youth. It is storied that he may have begun his love of architecture and engineering by seeking novel ways to harass a neighborhood rival, eventually resorting to pumping high-pressure steam under his neighbor's house to simulate an earthquake[170].



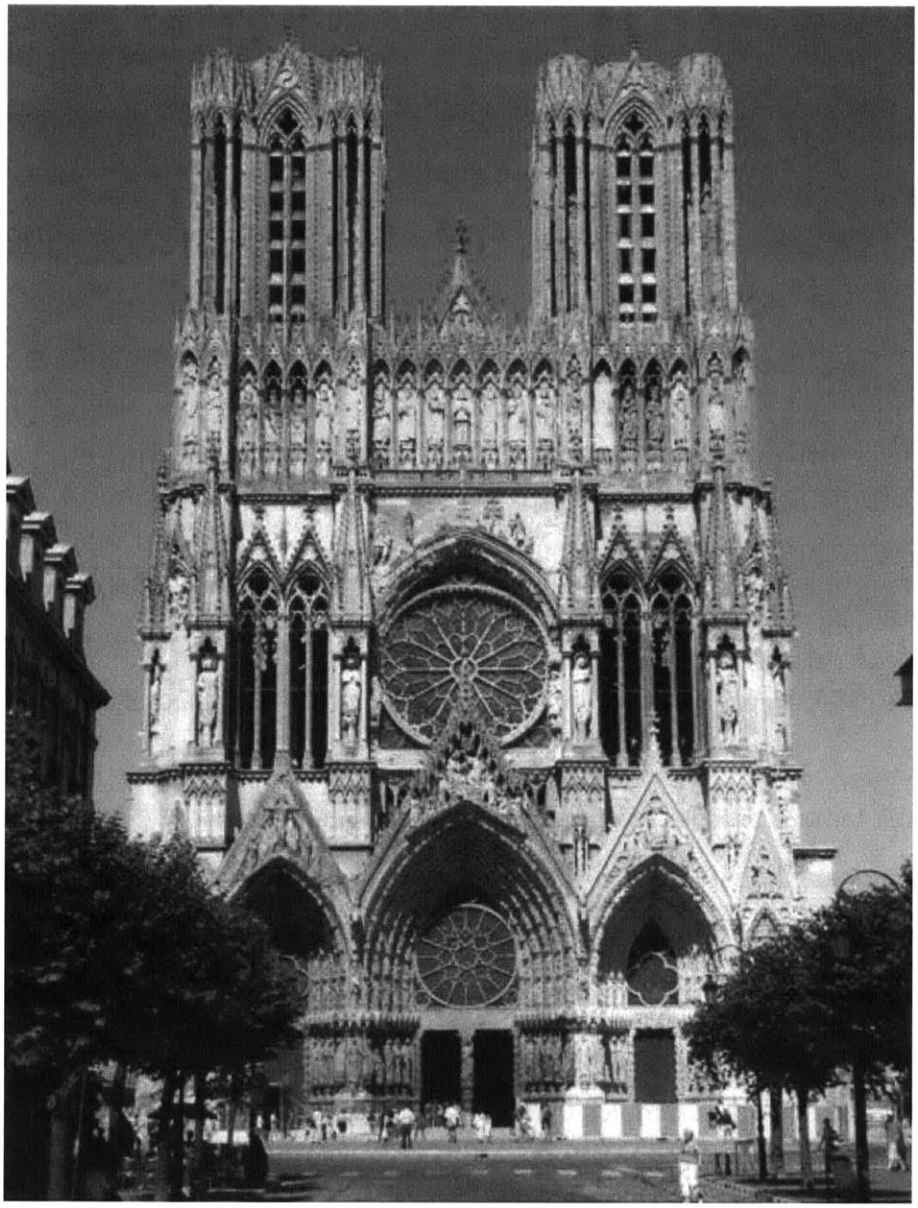
The Hagia Sophia in Istanbul

9.6 - De Coucy

Robert De Coucy (13th century AD) and his son of the same name were medieval French architects responsible for the building of the cathedral of Notre-Dame de Reims, or Reims Cathedral, known as the epitome of French Gothic architecture[172].

While almost nothing is known about either De Coucy's life, scholars have been able to describe their role in the building of Reims as equally that of an architect and a master builder. The elder of the two undertook the creation of the cathedral when a fire destroyed the church that stood in its place in 1211. After about 30 years, the front portion of the cathedral was completed, but the nave itself was not roofed until 1299. Construction continued into the 14th century[173].

In his book, *Gothic Architecture in France, England, and Italy,* Thomas Graham Jackson questions whether either De Coucy was involved in the building at all, instead crediting Reims to Jean of Orbais. Indeed, in the selection of De Coucy's name for inclusion on the new MIT buildings, it seems even the architecture faculty were dubious of his merit. Correspondences with President Maclaurin suggest his was the first name to be removed from the master list if it needed to be narrowed[174].



Reims Cathedral

9.7 - Giotto

Giotto di Bondone (1266-1337) was an Italian painter and architect best known for his fresco in the Scrovegni Chapel in Padua. He is considered one of the first Renaissance painters[175].

Though the exact location of his birth is disputed, Giotto is commonly known to have been born in or near Florence. He was taken as an apprentice at a young age by the accomplished painter Cimabue, and Giotto moved to work under him in Tuscany. Giotto married in 1287 when he was twenty, and over the next ten years, his various works began to crop up across Italy. He quickly gained fame and most likely started his own workshop, as he had come into significant wealth early in the 14th century. In 1334, he designed the bell tower of the Florence Cathedral. He died just three years later[175].

The most famous artist of his time, Giotto is considered by most scholars to represent a clear division between the middle ages and the Renaissance. His reputation earned him a mention in Dante's *Divine Comedy*[176], which only encouraged scholars to grow his legend and further point to him as one of the forefathers of the Renaissance era. Although history tends to unduly lionize individuals such as Giotto, this notion may have some credence in terms of artistic style: much of Giotto's work resembles that of artists who came forth fifty or more years after his death[176], exemplifying him as a true artistic revolutionary.

9.8 - Brunelleschi

Filippo Brunelleschi (1377-1446) was a famous architect during the Italian Renaissance. He is best known for his construction of the dome of the Florence Cathedral, known worldwide as simply, "Il Duomo".

Born to a notary in Florence, Brunelleschi showed significant artistic ability from an early age, and his father quickly removed him from his formal education to apprentice as a goldsmith. In his early twenties, he became interested in sculpture, and at twenty-four, he moved to Rome to study with Donatello, who had also apprenticed as a goldsmith[177]. During this time, Brunelleschi is credited with inventing the practice of linear perspective in painting, adding three-dimensionality to what used to be a strictly two-dimensional art form. Brunelleschi eventually undertook the project of building the dome for the Cathedral of Florence in 1920, the work for which would continue until his death[178].

At the time the dome was to be constructed, Brunelleschi and his rival, Lorenzo Ghiberti, both wanted control of the project. It was decided that the two would be put to a contest, the winner of which would be allowed to build the dome; the competition: make an egg stand vertically on a flat surface. Brunelleschi was able to secure his life's work by blowing on one side of the egg to hold it in place. Over the next 26 years, he would be responsible for laying over 4 million bricks on the dome, and he would eventually be granted one of the first patents for a machine he designed to hoist material to the top of the cathedral[179].

Brunelleschi's dome in Florence

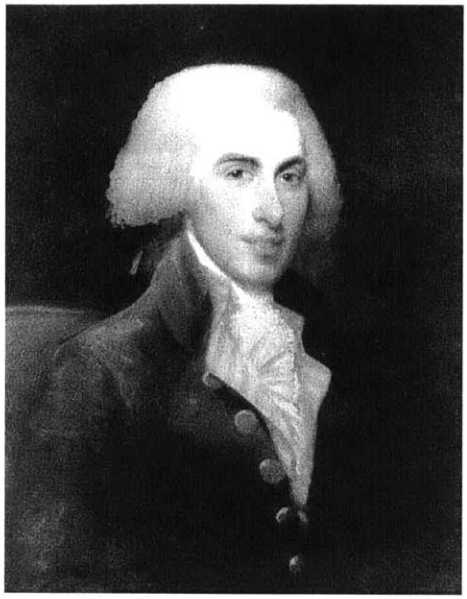
9.9 - Wren

Christopher Wren (1632-1723) is generally considered the greatest among all British architects. He is famous for designing St. Paul's Cathedral and rebuilding much of London after the Great Fire[180].

Born in East Knoyle in Wiltshire, Wren received an education from Wadham College in Oxford, where he studied science and mathematics. He continued on to become a Professor of Astronomy at Gresham College in London in 1657, where he would eventually help found the Royal Society, which would prove an integral body for the advancement of scientific knowledge in England. In 1666, the Great Fire destroyed a large portion of London, and Wren, having recently returned from studying architecture in Paris, became a surveyor to help rebuild the city. In doing so, he was responsible for the construction of 51 churches, including St. Paul's Cathedral, which was completed in 1710[181].

Upon his death, Wren was honored with a burial in St. Paul's. His epitaph reads, "Here in its foundations lies the architect of this church and city, Christopher Wren, who lived beyond ninety years, not for his own profit but for the public good. Reader, if you seek his monument – look around you."

St. Paul's Cathedral



9.10 - Bulfinch

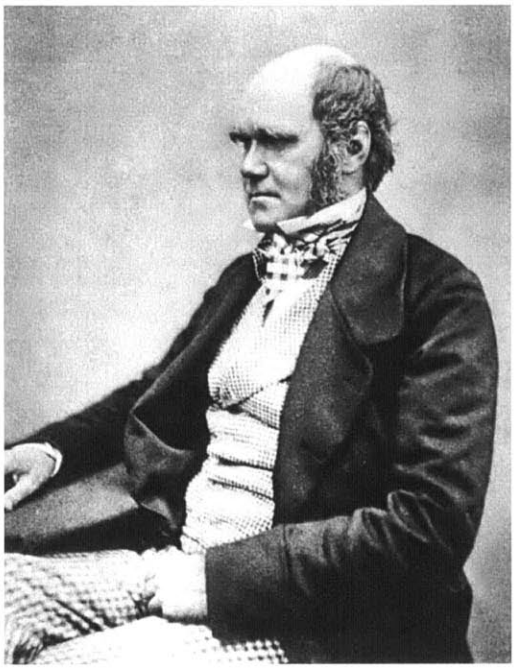
Charles Bulfinch (1763-1844) is generally regarded as the first American-born architect. He designed the United States Capitol rotunda and the Massachusetts State House[182].

Born in Boston to a well-known family, Bulfinch attended the local Boston Latin School before matriculating to Harvard. After his graduation, he toured Europe to observe the classical architecture, befriending Thomas Jefferson along the way. In 1787, he returned to the United States to begin an illustrious career as an architect in the American northeast, designing State Houses for Massachusetts, Maine, and Connecticut (which has since been replaced). He also worked diligently as the chairman of Boston's board of selectmen, a role that he used to improve the city's infrastructure[182].

Despite his diligent work, Bulfinch often found himself in financial trouble. A significant portion of his work was for minimal or no pay, and he was eventually imprisoned for a month in 1811 due to his debt. In an ironic twist of fate, he was jailed in prison of his own design[183].

The Massachusetts State House, visible from MIT

Building 1, Eastern Face
Observational Physicists



10.1 - Darwin

Charles Darwin (1809-1882) was an English naturalist famous for the theory of evolution outlined in his book, *On the Origin of Species.* The revolutionary ideas he put forth forever changed the way the life sciences were understood.

Born in Shrewsbury, England, Darwin was one of six children. After his mother died when he was at a young age, he attended the local Shrewsbury school, where he struggled in his learning of the classics. At the age of sixteen, he matriculated to the University of Edinburgh Medical School, where he generally neglected his studies in favor of learning natural history independently. He quickly moved on to seek a degree at Christ's College in Cambridge to further pursue his interests. Upon his graduation, Darwin was fortuitously met with an invitation to join a two-year expedition on the HMS Beagle's trip to chart the coastline of South America, and, with some help from his uncle, convinced his father to fund his journey. On the expedition, Darwin famously reached the Galápagos Islands, where he documented the different varieties of finches on the islands that would influence his burgeoning evolutionary theory. In 1859, he published his theory in *On the Origin of Species*, which became unexpectedly popular in both scientific and lay circles. For the rest of his life, Darwin further developed his theory, gathering evidence and postulating the origin of man. Though evolution was initially met with criticism, especially in religious circles, by the time of Darwin's death in 1882, most reputable scientists had accepted the theory[184].

10.2 - Guericke

Otto von Guericke (1601-1674) was a German scientist known for establishing the physics of vacuums. He is also credited with inventing the air pump.

Guericke was born in Magdeburg to a patrician family, though little else is known of his early upbringing. After briefly attending the University of Leipzig, his stay was cut short by the advent of the Thirty Years War, and he received a scattered education in law at Helmstedt and Jena between 1620 and 1622. He furthered his studies at the University of Leiden, where he supplemented his legal education with courses in mathematics and engineering. He was immediately elected to political office when he returned to Magdeburg in 1626, and he eventually took a second job as a city contractor four years later. 1632 marked the beginning of a twenty-year stint as a diplomat, and the tiresome work eventually forced Guericke to develop a secondary hobby of inventing. Around 1650, Guericke produced a vacuum pump, the first of its kind, dispelling the long-upheld notion that vacuums could not exist. Guericke continued to create other inventions that operated on a vacuum principle and even began to dabble in electrostatics before his death in 1764[185].

10.3 - Torricelli

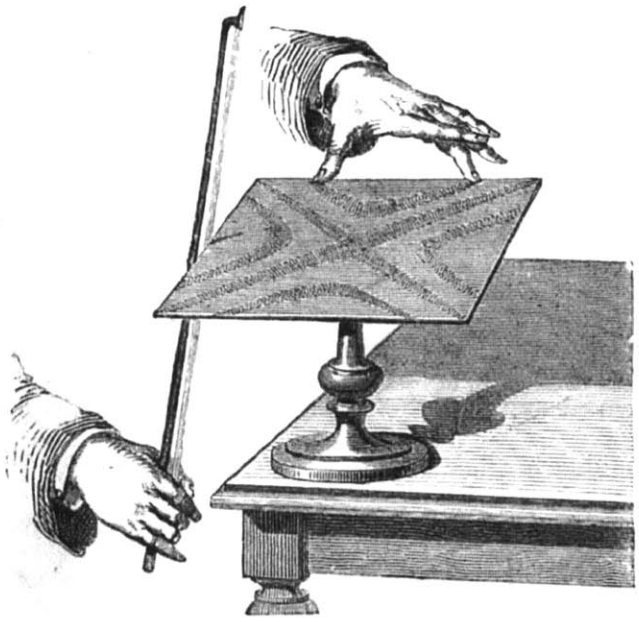
Evangelista Torricelli (1608-1647) was an Italian physicist famous for his invention of the barometer.

Born to a modest family in the papal state of Ravenna (now part of Italy), Torricelli exhibited a keen intellect from an early age. He attended classes in mathematics at the local Jesuit school before moving to Rome in 1626 to learn from the hydraulic engineer Benedetto Castelli, who himself studied under Galileo. It is known that Torricelli actively corresponded with Galileo (some of his letters still survive today), and in 1641 he moved to Galileo's home to actively seek his mentorship. During this time, he invented the barometer and developed Torricelli's Law, a particular case of the then-undefined Bernoulli principle. He died from typhoid shortly thereafter in 1647[186].

10.4 - Chladni

Ernst Chladni (1756-1827) was a German physicist who studied acoustics. His research included calculating the speed of sound for different gases, though he also dabbled in the study of meteorites[187].

Chladni was born to an ethnic Slovakian family in Wittenberg, Germany. Abiding by the wishes of his father, he received a degree in law from Leipzig in 1782, but, upon his father's death, his focus switched to science. An amateur musician, Chladni was drawn to the field of acoustics, and he published his first treatise on vibrating plates in 1787, in which he used his famed sand figure method. In the method, Chladni put sand on a glass or metal plate fixed at a single point and drew a bow across its edge. The plate then vibrated, moving the sand to the nodal points in the vibrations, often producing interesting geometric patterns[187]:



In addition to his other pursuits, Chladni invented two instruments during his lifetime. The first, the Euphon, consisted of glass rods and was an early predecessor to the Cristal Baschet. His other instrument, called the Clavicylinder, never took off[188].

10.5 - Huygens

Christiaan Huygens (1629-1695) was a Dutch astronomer and physicist who discovered Saturn's moon Titan. He also invented the pendulum clock and made significant advances in probabilistic mathematics.

Born to a wealthy family in The Hague, Huygens was educated by private teachers in his home until the age of sixteen. He studied law at the Collegium Arausiacum at Breda but afterwards returned home to study science independently, during which time he benefitted from his father's relationships with prominent thinkers of the time, including Rene Descartes[189]. From his graduation in 1649 to 1666, Huygens produced his greatest works in mathematics, physics, and astronomy, publishing many papers and books, including the first full text on probability theory. During his time, Huygens served as something of a scientific diplomat, developing relationships with many of the other great minds of the era. Notable among his many friendships were those of Blaise Pascal, Robert Boyle, and Sir Isaac Newton. He even tutored a young Gottfried Leibnitz, who later became the co-inventor of infinitesimal calculus in mathematics[190].

Huygens is also known as one of the early prominent scientists to speculate about extraterrestrial life. In his *Cosmotheros*, he imagines other planets similar to Earth that could host life due to the availability of water, though he speculated that these other worlds must be so far apart that their species could never meet. In 1997, NASA launched its Cassini probe toward Saturn with a secondary probe named for Huygens bound for Titan. Somewhat ironically, the Huygens probe was designed for a liquid landing[191].

10.6 - Young

Thomas Young (1773-1829) was an English scientist and polymath who made advances in a wide range of fields including solid mechanics, physiology, and physics. He may be best known for his famous "double-slit" experiment to help establish the wave theory of light. Young was also among the first to translate Egyptian hieroglyphics.

A Quaker born in Somerset, Young was one of ten siblings. From an early age, he showed significant skill in language, reading through the entire Bible twice before he turned six. By the time he matriculated to Emmanuel College in Cambridge, he had independently studied thirteen different languages and had developed an interest in mathematics and chemistry[192]. In 1800, Young established a medical practice in London which met little immediate success, mostly due to his difficult bedside manner[193]. The practice did, however, benefit him with the acquaintance of Count Rumford through the Royal Society, and Rumford employed Young as a professor of natural philosophy at the Royal Institution a year later (though he would abandon the post in 1804 in the interest of his faltering medical practice). He eventually secured a career at St. George's Hospital in 1814, his time away from which he spent pursuing his other assorted interests. In 1822, Young published his translation of Egyptian hieroglyphs with the aid of the Rosetta Stone, discovered twenty-three years earlier[192].

Focused as Young was on his career as a physician, his knowledge in the other sciences was unparalleled during his lifetime. There was virtually no scientific question he could not answer[194], and he conducted critical research in a number of areas. In addition to his famous light experiments, Young established a measure for the elasticity of a material that now bears his name. It should be noted, however, that Young's modulus was actually first conceived by Giordano Riccati twenty-five years prior to Young, though he failed to publicize his findings. Leonhard Euler also had similar thoughts on the subject in a 1927 paper.

10.7 - Fresnel

Augustin-Jean Fresnel (1788-1827) was a French physicist best known for his contributions to light theory. He is famous for his invention of the Fresnel lens, which is widely used today[195].

The son of an architect, Fresnel was born in the town of Mathieu. Harboring an interest in science from a young age, he was admitted to the École Polytechnique in Paris in 1804 with the intent to become an engineer. He worked on roads for the French government until 1814, when Napoleon's return from Elba compelled him to join the Royalist military. Upon his return, he switched his focus to research on the wave properties of light[i]. Working for the lighthouse commission, he developed his famous lens that reduced the required size to achieve a short focal length with a large aperture[196].

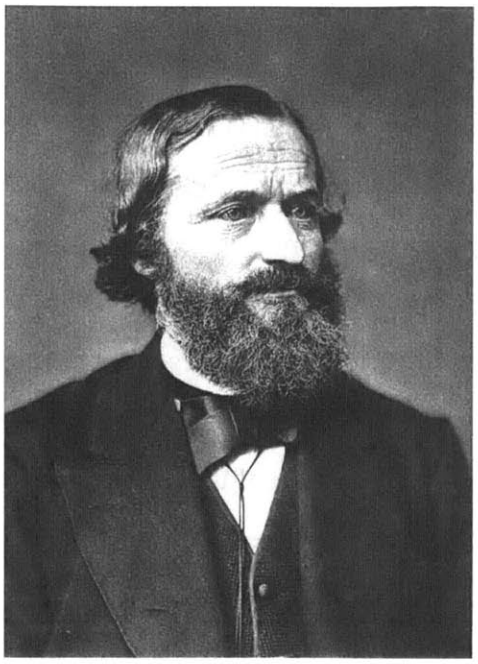
Throughout his life, Fresnel was plagued by tuberculosis, eventually leading to his early death. He was constantly exhausted, a condition that was exacerbated by his travel to Paris for public works. Nonetheless, he poured himself into his work, and his achievements were significant enough to earn a place for his name among seventy-one others on the Eiffel Tower[195]. There is no doubt that, given his love for his country, he'd be more honored by his permanent place in Paris than in Cambridge.

10.8 - Daguerre

Louis-Jacques-Mandé Daguerre (1787-1851) was a French artist famous for his invention of daguerreotype photography.

Born in Cormeilles-en-Parisis, Daguerre received training in various artistic practices before he narrowed his focus to theater design. He became well known after his invention of the diorama in 1822, and used his notoriety to earn himself a seat at the table with Nicéphore Niépce, one of the early pioneers of photography[197]. After years of development, Daguerre had developed a method of forming an image on a highly polished silver plate, and he took his new photography process public in 1839. His invention became the first commonly adopted form of photography and gained widespread use across the globe[198].

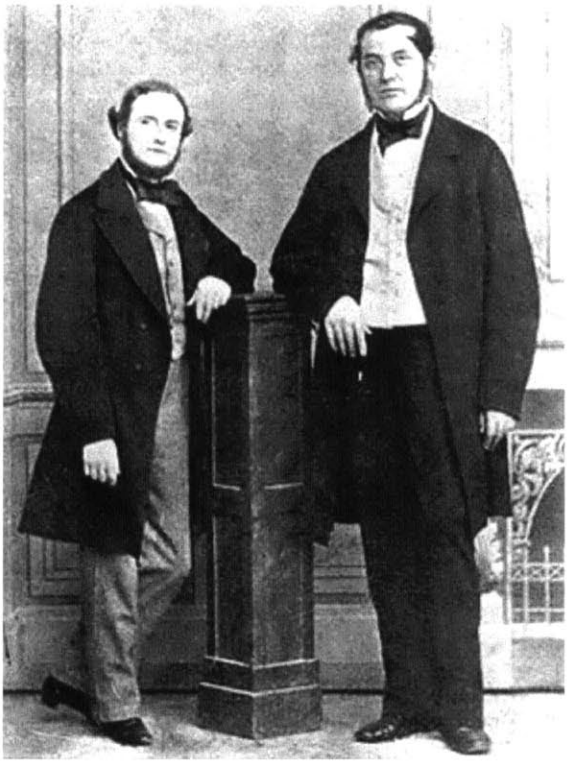
Daguerre's invention secured him relative comfort for the rest of his life. Though he met some initial resistance, he traded his design with the French government for a pair of lifelong pensions: one for himself and one for Niépce's son, who had unexpectedly lost his father six years earlier. The government, in turn, made the plans public in what it deemed "a gift to the world"[197].



10.9 - Kirchhoff

Gustav Kirchhoff (1824-1887) was a German physicist who studied electricity and thermodynamics. He is best known for his law of electromagnetic radiation as well as his laws that describe electrical current which bear his name.

Born in Königsberg, Prussia (now Russia), Kirchhoff remained in his home town for his primary and secondary education at Albertus University. While still an undergraduate, he developed his circuit laws which are ubiquitous in their use today[199]. After his graduation, he lived a typical academic life, establishing himself as a professor at Breslau before moving to the University of Heidelberg, where he proposed and formalized his law of thermal radiation in 1861. At Heidelberg, Kirchhoff worked with Robert Bunsen to develop the practice of spectroscopy, as well as discover the elements cesium and rubidium[200]. In 1875, he became the chair of theoretical physics at the University of Berlin, a position he would hold until his death in 1887[199].



Gustav Kirchhoff (left) and Robert Bunsen (right)

Among the most integral of Kirchhoff's discoveries was his law of thermal radiation, which ties the electromagnetic energy emitted by a body to a specific wavelength of light. This conclusion opened the door for the entire field of quantum mechanics, which would be developed throughout the 20th century[199].

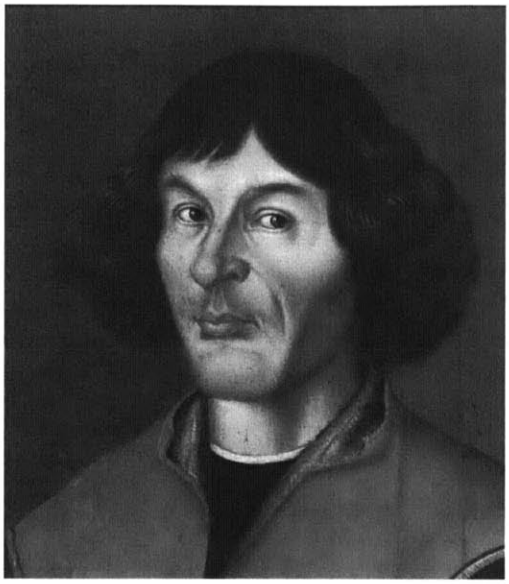
10.10 - Rowland

Henry Augustus Rowland (1848-1901) was an American physicist known for the high-quality diffraction gratings he made for spectral analysis. He also determined the exact value of the Ohm.

Born to a pastor in Honesdale, Pennsylvania, Rowland was placed in the Phillips Academy in Andover for his early education, in an attempt to set him on track for an education at Yale, where his father and grandfather had both attended. An interest in science and mathematics, however, drove Rowland to Rensselaer Polytechnic Institute in New York, where he studied civil engineering[201]. After two years as a railroad surveyor, he returned to his alma mater as a professor and established himself as one of the most promising young physicists in the United States with his research in the magnetic permeability of various metals. In 1876, Rowland became the chair of physics at the Johns Hopkins University, and he used his influence to build one of the best experimental physics facilities in the world[202]. At Johns Hopkins, he solidified his reputation among physicists by measuring the exact value of the Ohm and documenting the temperature-variability of the specific heat of water. He later invented a high-quality diffraction grating for use in astronomical spectroscopy toward the end of his career.

Rowland's best-known invention, his diffraction grating, is typical of the painstaking precision that characterized his work throughout his life. At the time, the best available grating had thirty thousand scores per linear inch and was too inconsistent for scientific use. Rowland's production method increased this number to forty-three thousand perfectly parallel scores. Upon his death, Rowland's ashes were interred within the walls of the laboratory in which he developed his famous technology[201].

Building 1, Northern Face
Civil and Mechanical Engineers



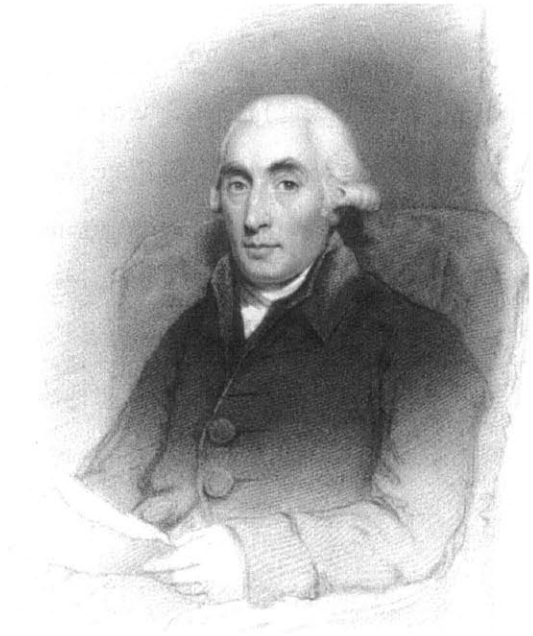
11.1 - Copernicus

Nicholas Copernicus (1473-1543) was a German mathematician and astronomer best known for his heliocentric model of the solar system, the first of its kind published in modernity. His book, *De revolutionibus orbium coelestium (On the Revolutions of the Celestial Spheres)*, laid the groundwork for all of modern astronomy[203].

Copernicus was born in the Prussian city of Toruń. After losing his father shortly after his tenth birthday, he was raised and presumably schooled by his uncle before he matriculated to the University of Krakow in 1491. His uncle, a bishop, wielded the influence necessary to elect Copernicus a canon of the cathedral chapter of Frauenburg, securing his nephew's finances. Under the guise of studying for his new position, Copernicus enrolled in the University of Bologna in 1496, but he secretly continued the study of astronomy he had begun in his youth. Copernicus's voracious appetite for knowledge, however, was not limited to any single field. In 1501, he was granted leave from his chapter to study medicine in Padua for two years, though he would remain in Frauenburg for forty years after his return, by which point he had amassed skills in mathematics, astronomy, medicine, and a number of other fields. In Frauenberg, he built an observatory from which he would develop his revolutionary theories of celestial motion. In 1514, he published his famed *De revolutionibus,* which described a heliocentric universe of infinite size. After the publication of his opus, Copernicus furthered his other endeavors while maintaining his astronomic research. He played a major role in Prussian monetary governance, establishing some of the fundamental laws of economics in the process. He continued to work as a physician as well, attending to the health of Duke Albert in Königsberg during the early 1540's before his death[204].

Like many of the astronomers who would come to follow him, Copernicus was wary of the religious implications of his heliocentric claims. To test the waters, he anonymously circulated a rough draft of his *De revlutionibus* to some close friends, though he none-too-subtly

referenced his observations in Frauenburg, where he was the only known astronomer at the time. Copericus's caution was not unfounded. When the responsibility of printing his work was passed to a more skeptical editor, Andreas Osiander, while Copernicus was on his deathbed, the editor inserted the a foreword that implied the work was pure conjecture, even though the astronomer's observations were supported by observational evidence[203].



11.2 - Black

Joseph Black (1728-1799) was a Scottish physicist and chemist famous for his discovery of latent and specific heats of matter. He also discovered carbon dioxide.

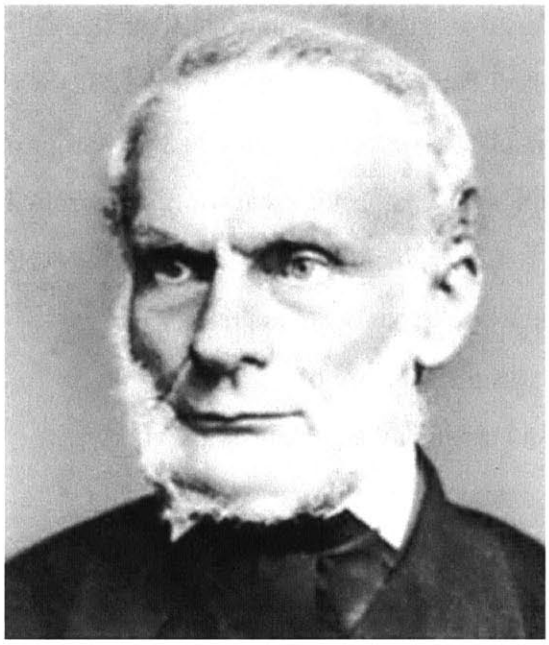
Though he was born in France to a Scottish wine merchant, at the age of twelve Black was sent to Belfast, where he began his education. In 1744, he matriculated to the University of Glasgow where, under pressure from his father, he began the study of medicine. A series of lectures by William Cullen, however, inspired Black to adopt chemistry as his secondary focus, and he eventually took a position as Cullen's assistant. He received his M.D. from the University of Edinburgh in 1754, eventually publishing his thesis dissertation in what would become his only majorly circulated work. Black spent the subsequent ten years as a professor at Glasgow, where he developed his ideas on specific heat, which he would never publish. At Glasgow, Black developed an illustrious reputation as a teacher, eventually rejoining Cullen in Edinburgh in 1766. He would remain there until his death thirty-three years later[205].

11.3 - Rumford

Sir Benjamin Thompson (1753-1814), also known as Count Rumford, was a British physicist known for his work in thermodynamics. He is most famous for his efficient furnace design and his experiments with frictional heating, which set the stage for the laws of conservation of energy.

Though he was born in Woburn, Massachusetts, Thompson remained loyal to the British crown during the American revolution. His early education was limited, but a fortuitous marriage at the age of nineteen to an influential widow established him as a land-owner in New Hampshire, where he was appointed a major in the local militia. At the beginning of the revolution, Thompson acted as a spy for the British, informing on the revolutionary movements and recruiting loyalists for the Crown. After the fall of Boston in 1775, Thompson's estate was attacked, and he fled to London, leaving his wife and newborn daughter behind. He continued to actively serve in the British military until 1784, at which point he retired with the rank of colonel. The next year, Thompson took his military experience to Bavaria, where he was tasked with organizing the army and alleviating the area's rampant poverty. He set the Bavarian lower class to work producing weapons, clothing, and other necessities for the military, an endeavor that benefited from Thompson's innovative mind. In addition to inventing many low-cost goods, his experiments with cannon yielded his critical observations on the nature of thermodynamics, and he was elected a Foreign Honorary Member of the American Academy of Arts and Sciences in 1789. After another ten years in Bavaria, Thompson returned to London, where he established the Royal Institution of Great Britain, hiring Humphry Davy and Thomas Young as full-time research scientists and lecturers. Around this time, he married the widow of the recently deceased Antoine Lavoisier, though he divorced her within the year. Nonetheless, he continued his research in Paris until his death in 1814[206].

Thompson's life is truly the stuff of legend. His escapades border on fantasy, and the circumstances of his life could not have been more unusual. Through all his excursions in Europe, however, he managed to stay connected to his past life in New Hampshire, taking Rumford, the former name of his home of Concord, New Hampshire, as his title when he was made a Count of the Holy Roman Empire[207].

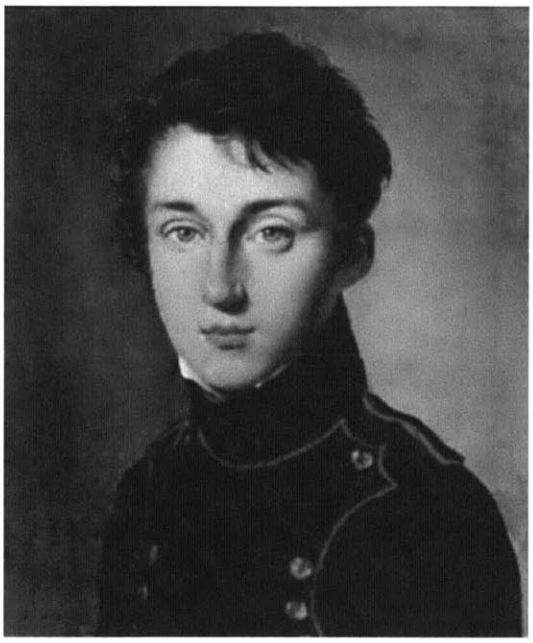


11.4 - Clausius

Rudolf Clausius (1822-1888) was a German physicist famous for introducing the concept of entropy into the study of heat. He was the first to state the essential nature of the second law of thermodynamics.

Born in Köslin, Prussia (now Poland), Clausius began his education in a school established by his father before eventually matriculating to the University of Berlin in 1840, where he studied mathematics and physics. He pursued a typical academic life, receiving his doctorate from the University of Halle before finding a teaching position at the Royal Artillery and Engineering School in Berlin, on the heels of his first major paper on the theory of heat (1850). In 1855, he moved on to the new Polytechnicum in Zurich, where he published a paper that not only mathematically described, but also named, his new quantity of entropy in 1865. Two years later, homesickness drove Clausius back to Germany, first accepting a professorship at Würzburg and later Bonn, where he remained until his death in 1888[208].

In addition to being a prolific physicist, Clausius was a staunch German nationalist. Undoubtedly fueled by the zeitgeist in the growing power, Clausius was often combative with foreign scientists, including Lord Kelvin, with regards to which nation laid intellectual claim to many of the findings in thermodynamics. Clausius's nationalism eventually led him to take a leave of absence during the Franco-Prussian War, rallying some of his Bonn students to form an ambulance corps. He was awarded the German Iron Cross after suffering a leg wound in battle that would leave him permanently disabled[208].



11.5 - Carnot

Nicolas Léonard Sadi Carnot (1796-1832) was a French physicist, described by some as the "father of thermodynamics". He is best known for his theoretical work on heat engines, including the famous thermodynamic cycle that bears his name.

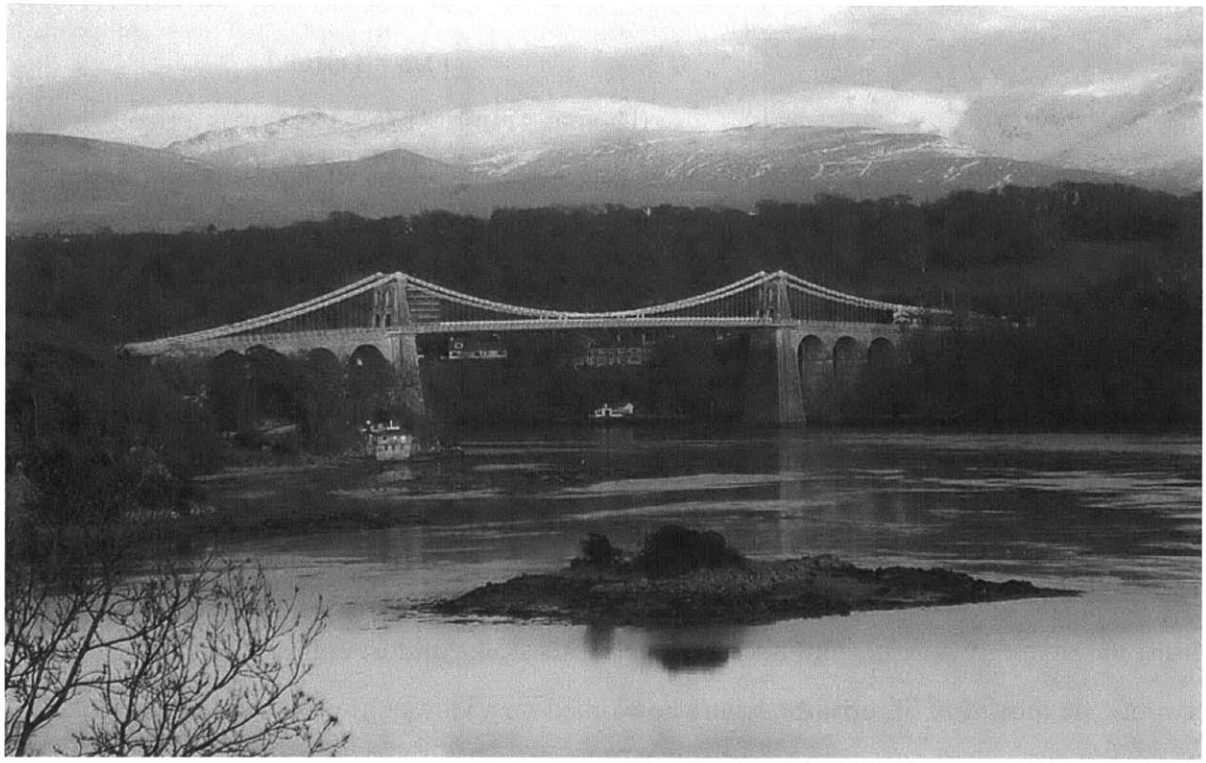
Sadi was the first son of Lazare Carnot, a prominent mathematician and statesman who was a leader of the French Revolutionary Army. After removing himself from the public sphere in 1807, Lazare raised and educated his sons in Paris, and Sadi's aptitude earned him admission to the École Polytechnique at the age of sixteen. At the École, Carnot received instruction from some of the greatest minds of the time, including Siméon Denis Poisson, Joseph-Louis Gay-Lussac, and André-Marie Ampère. In 1814 before his graduation, Carnot began his military career by joining Napoleon's forces with fellow students in the Siege of Fort Vincennes. After furthering his engineering education at the École du Génie at Metz, he entered the engineering regiment, but he found the work of building fortifications tedious and ended his service in 1819. He spent the rest of his life dedicating his skills to private pursuits, including the development of his engine theory[209]. At the age of 36, he suddenly became ill with scarlet fever before succumbing to the cholera epidemic in the August of 1832. Upon his death, all of his personal effects, including his notes, were burned, as was custom, and the world forever lost Carnot's work from the final years of his life[210].

Though Lazare worked arduously to further his sons' development, Carnot began to develop difficulties, especially in his military life, upon his father's exile in 1815. Growing resentment from his peers undoubtedly played a role in Carnot's abandonment of his military duties four years later, though it does not seem he ever resented his father's circumstance. In 1821, Carnot journeyed to Magdeburg to visit Lazare in a trip that had an inspirational effect on the young scientist, and he returned to Paris with a new focus on issues with the steam engine, eventually leading to his most influential work[209].

11.6 - Telford

Thomas Telford (1757-1834) was a Scottish civil engineer who constructed the Menai Bridge in Wales. Over his lifetime, he designed over one hundred bridges throughout the United Kingdom.

Telford grew up on a farm in Dumfriesshire having never known his father, who died when he was an infant. He received little formal education but was apprenticed to a stonemason as a teenager, during which time he developed an interest in architecture. He quickly found himself in London, where he continued to develop his skills, almost entirely learned on-the-job. At twenty, he moved to Shropshire, where he worked on a variety of projects, including the construction of over forty bridges. As a frontiersman the burgeoning field of civil engineering, Telford was able to use his practical knowledge and intuition to develop innovations such as materials research. His completed construction of the Ellesmere Canal in 1805 secured his international fame, and he was widely contacted as a consultant on the construction of bridges, aqueducts, and other canals. In 1826, he completed the Menai Suspension Bridge, the longest of its kind during the period, connecting the Isle of Anglesey to the mainland. Telford died in 1834[211].



Telford's famous Menai Bridge

11.7 - De Lesseps

Ferdinand de Lesseps (1805-1894) was a French diplomat responsible for developing the Suez Canal.

Born to a family of career diplomats at Versailles, it seems de Lesseps's future career was determined from birth. He spent most of his early life in Italy, where his father served the interest of the French government. After receiving an education at the College of Henry IV in Paris, at the age of twenty de Lesseps was appointed assistant vice-Consul in Lisbon. Further assignments brought him to Tunisia and eventually Egypt, where in Alexandria he studied a proposal written by one of Napoleon's engineers for the Suez Canal. Though he was interested in the proposition, plagues in Cairo and Alexandria hindered de Lesseps for more than two years before he returned to Paris, exhausted from his efforts to control the disease. He spent most of the 1840's in Rome when Pope Pius IX left the Vatican, and it was only after his retirement from diplomacy in 1851 that de Lesseps was able to return to the idea of the Suez Canal with which he had become acquainted more than twenty years prior. In 1854, he secured the blessing of the local government and began to organize the canal's construction, which was completed in 1869[212].

The Suez, however, wasn't the only canal de Lesseps attempted to build. In 1879, the French government approved the construction of a canal connecting the Atlantic and Pacific oceans in Panama, electing de Lesseps to lead the project. Unfortunately, the project was doomed from its beginning when it was decided that the Panama Canal, like the Suez, would operate without locks. The added strain placed on construction was only exacerbated by corruption and dangerous working conditions, and the Panama Canal Company tasked with the construction declared itself bankrupt in 1888. Ultimately, the Panama Canal was completed in 1914 with a modified design that included a set of six locks[213].

11.8 - Rankine

William Rankine (1820-1872) was a Scottish physicist and civil engineer known for his contributions to thermodynamics. He is most famous for his Rankine cycle in heat engines.

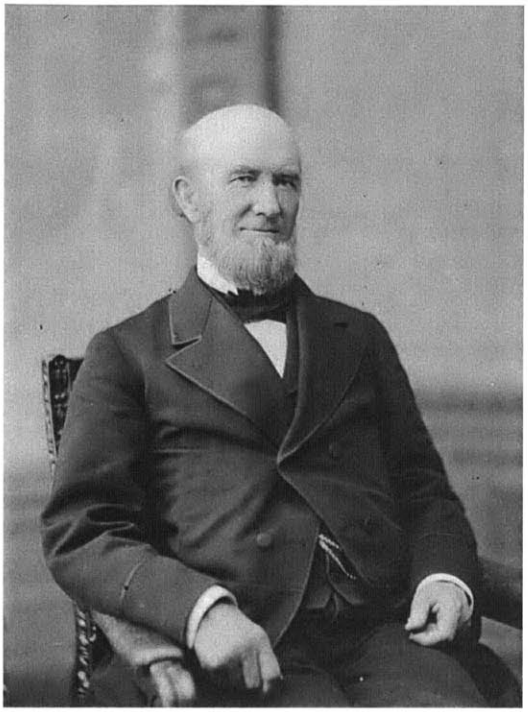
Born in Edinburgh, Rankine was the son of an army lieutenant. He was in consistently poor health as a child and was schooled at home before entering the University of Edinburgh at the age of sixteen to study natural philosophy. He left Edinburgh without a degree, opting instead to work on railway-related engineering applications with John MacNeill, who himself had been an assistant to Thomas Telford. By the time he was thirty, Rankine had developed a reputation as a consulting engineer, being elected to the Royal Society of Edinburgh in 1850 and the Royal Society of London in 1853. Around then, his research in heat engines had allowed him to develop his famous thermodynamic cycle, which is still used in engineering today. In 1855, he became a professor of civil engineering and mechanics at the University of Glasgow, where he would work for the rest of his life. There, he used his own research and experience to write a set of textbooks which became standard reading in engineering education even for decades after his death in 1872[214].

Rankine harbored a great number of interests outside of his chosen field of engineering. In his spare time, he played the cello and piano, often composing humorous songs to entertain his friends[215]. Among these was a poem titled "The three-foot rule" that Rankine wrote in protest to the adoption of the metric system:

When I was bound apprentice, and learned to use my hands,
Folk never talked of measures that came from foreign lands:
Now I'm a British Workman, too old to go to school;
So whether the chisel or file I hold, I'll stick to my three-foot rule.

Some talk of millimetres, and some of kilogrammes,
And some of decilitres, to measure beer and drams;
But I'm a British Workman, too old to go to school,
So by pounds I'll eat, and by quarts I'll drink, and I'll work by my three-foot rule.

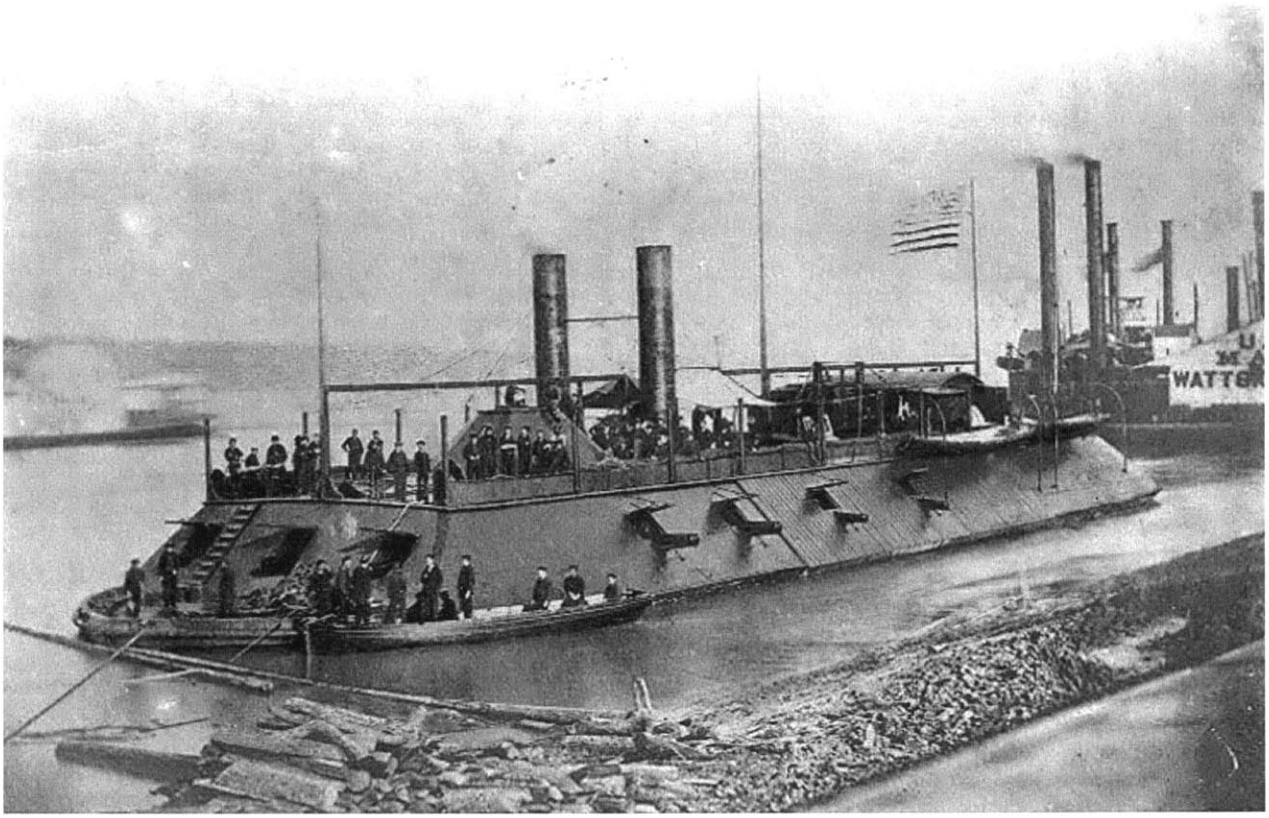
A party of astronomers went measuring the earth,
And forty million metres they took to be its girth;
Five hundred million inches, though, go through from pole to pole;
So let's stick to inches, feet and yards, and the good old three-foot rule.



11.9 - Eads

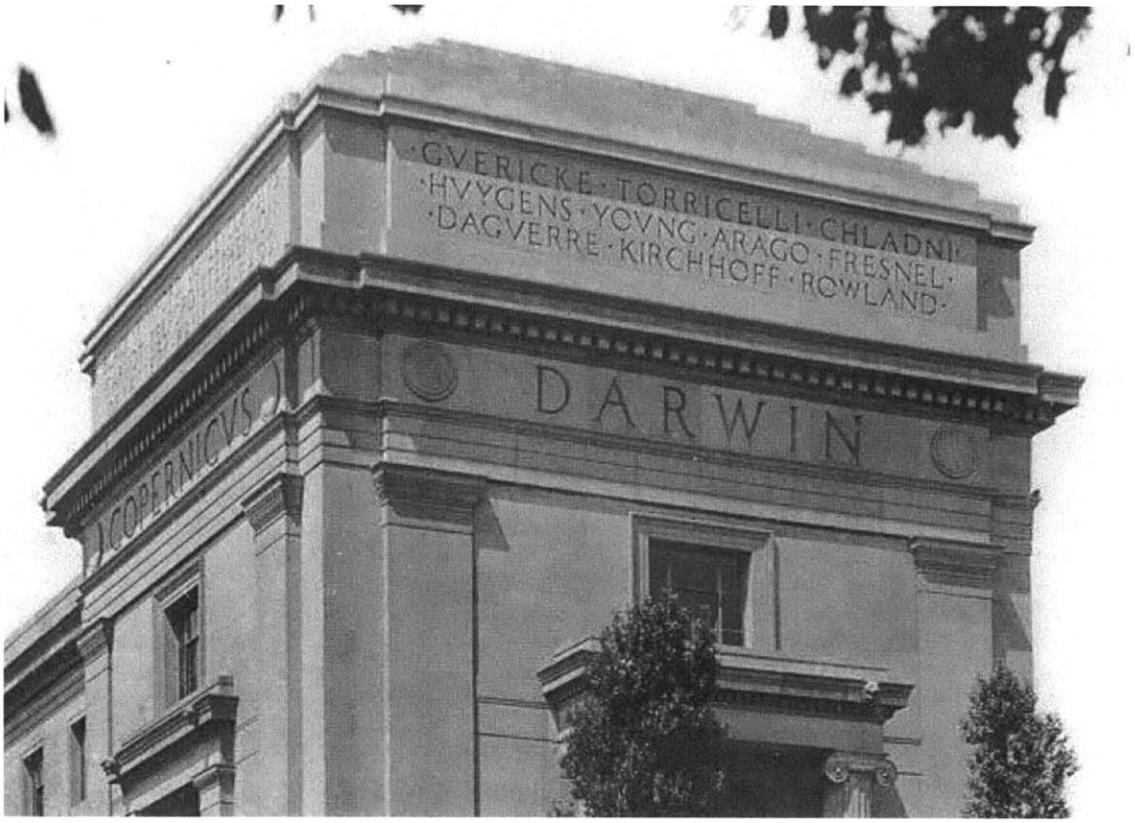
James Buchanan Eads (1820-1887) was an American civil engineer, naval architect, and inventor famous for developing a series of ironclad ships for the United States Navy during the American Civil War. He filed more than fifty patents in his lifetime[216].

Born in Lawrenceburg, Indiana, Eads was named for his second-uncle, who would later become a United States President. When Eads was a child, his father had difficulty finding work, and the family's constant relocation resulted in a sparse to nearly nonexistent formal education. Eads was thirteen when they finally settled in St. Louis, Missouri, and he abandoned his schooling to help support his family as a delivery boy for a local dry goods store. Fortunately, his supervisor recognized the young boy's gifted mind and allowed him to spend time in his library. Soon, Eads began to invent and tinker at home and, at twenty-two, became self-supporting with his invention of a diving bell apparatus for use with salvage operations after riverboat disasters. After a brief, successful career, Eads had retired young before the onset of the American Civil War brought him back to work as a ship builder, during which time he would construct over thirty ironclads for the Union. After the war, Eads continued to work as a civil engineer, designing bridges and jetties around the Mississippi river. He died in his adopted home of St. Louis in 1887[216].



City-class gunboat designed by Eads

12. Conclusion



Almost a century after their selection, the names of these 115 men can still be seen adorning the buildings at the southern end of MIT's Killian Court. The most prominent names, Aristotle, Newton, Franklin, Faraday, Pasteur, Archimedes, Lavoisier, da Vinci, Darwin, and Copernicus are as relevant now to the pursuit of scientific knowledge and natural truth as they ever were. Some others, listed below them, have become nearly anonymous in the 21st century. For a select few, the insights they offered during their lifetimes have even exceeded their potential as it was in 1915 when they were chosen.

Each of the men who contributed to Maclaurin's final list brought their own biases to the table in its development. Maclaurin, originally from Edinburgh, Scotland, was himself a known anglophile[133], and the final assemblage of names is conspicuously devoid of scientists outside the European sphere. A combination of attitudes in 1915 and the nature of scientific development itself before the 20th century prevented any women from making the list, as well.

Who did Maclaurin miss? How different might the final one hundred and fifteen names have looked if those involved had put it together with modern attitudes? As the Institute steps

into a new century, such questions may be important to ask as we continue to honor those who lay the scientific groundwork for those ahead. If MIT were to find more space to honor individuals from the 20th century, who would be included? Albert Einstein seems an obvious choice; Marie Curie as well. What about Alexander Graham Bell, who was so heralded by his contemporaries in 1915, despite the fact that he was still living at the time of construction[2]? Has his relevance been too diminished by the last century, or should the opinions of those who chose the original 115 names still be honored?

It is, perhaps, only when we look at the issue of ranking the contributions of more modern scientists, engineers, and inventors that we can truly realize the immensity of the task Maclaurin chose to undertake. The process by which these men were nominated, selected, and removed may have been an imperfect one, but it is impossible to discount the intense deliberation required of Maclaurin and his colleagues over a brief two-week period in May of 1915.

Such fervent leadership characterized Maclaurin's relationship with the Institute, and, after his death, he was commemorated with the following words in the lobby of Building 10:

> "These buildings dedicated in the year nineteen hundred sixteen stand as an enduring monument to Richard Cockburn Maclaurin, whose energy, vision, and leadership as president from nineteen hundred nine to nineteen hundred twenty established the Massachusetts Institute of Technology in this more ample home and guided it into a new era of strength and stability."

It is a fitting monument to a man who created the MIT we know today, but if one wanted to know how Maclaurin would have felt about the completion of the New Technology and its dedication to the men who truly built it, they ought look no further than the inscription Maclaurin had engraved above his own fireplace in his office: *Alia initia e fine*, "Out of each thing brought to conclusion, the beginning of something else."

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