Chapter 03 - The Spread of Knowledge via Print

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The Spread of Knowledge via Print

Richelle McDaniel

While printing had already existed for several centuries, Johannes Gutenberg turned the printing world upside down and brought on a new era of print with his revolutionary innovation of movable type in 1445. Movable type printing used metal stamps of single letters that could be arranged into different words, sentences and pages of text. Using a large manually operated machine, the stamps would be arranged to read a page of text so that when covered with ink, it would print out a page of text. Before Gutenberg, all texts had been printed with woodblocks or fixed text stamps, both of which were complex and time-consuming processes. Movable type kept the metal stamp letters separate, which allowed printers to reuse the letters quickly on succeeding pages. As a result, more pages could be efficiently printed in a shorter amount of time with much less effort. From here, the opportunity to share ideas and knowledge brought on a new era of change and enlightenment never seen before. The movable type printing press, however, didn’t affect all areas equally.

Print and the Power of Religious Knowledge

The first book printed with movable type was Gutenberg’s Bible. Gutenberg started off printing forty lines per page but began printing forty-two lines per page instead. Scribes, on the other hand, only wrote thirty-six lines per page in earlier bibles. By fitting more lines per page, the Gutenberg Bible limited the amount of paper and parchment needed to produce a bible. The movable type also allowed for fast production of the bibles. While scribes took

Movable type sorted in a letter case and loaded in a composing stick on top.
three years to produce a single product, Gutenberg produced a total of 180 copies; 150 bibles on paper and 30 on vellum. Fast production and fewer materials decreased the price and increased availability of the bible, thus providing more opportunities for anyone of any economic status to own and read a private family bible. As long as they were literate, many citizens no longer needed to rely on religious authorities for knowledge, interpretation, and analysis of religious literature. They could form their own intellectual opinions concerning the bible and their faith through reading. This shift in power from the religious authority to the people was a common effect of more accessible and inexpensive print, particularly in the religious sector of European culture during the fifteenth and sixteenth centuries.

Interestingly, the Catholic Church was one of the biggest early customers of printing press. The Catholic Church utilized the press for printing ordinances, indulgences and anti-Islamic Crusade propaganda during the late 1400s and early 1500s. Thus, it wasn’t surprising that numerous monasteries hailed the printing press as a gift from God.

Similarly, by the end of the fifteenth century, the majority of Western Europe cities had a printing press. Nearly eight million books, most of which were religious, were printed using the printing press by 1500. This is about 180 times the amount of books which could be produced by a scribe within the same time. The decrease in cost of book materials due to technological production changes (namely paper and ink), as well as mechanization of the printing process allowed for mass production of less expensive books. This overall decrease in price led to an increase in literacy in Europe during the fifteenth century. At the same time, the lower and middle classes begun to develop an interest in reading since they could afford personal religious texts. Since reading spurs the formation of intellectual opinions, a large part if the population now began to read their own personal bibles and form their own opinions, which didn’t always align with that of the religious authority figures. Disagreements between the two parties on biblical interpretation played a role
in sparking social upheaval and eventually the Protestant Reformation. With an increase in literacy, the more opportunities to own personal religious texts and growth of individual reading, the printing press ultimately undermined the Catholic Church and disrupted the European religious culture by spreading religious knowledge and shifting the power to the people.

Martin Luther was the vehicle responsible for spreading knowledge of the Bible to a large population during the sixteenth century, ultimately sparking the Protestant Reformation. For centuries, Catholicism was the religion of Europe. Although Luther loved the Church, he had his reservations concerning the corrupted sale of indulgences by certain religious authority figures, including but not limited to Frair John Tetzel of Germany. Under Catholic teaching, every sin must be absolved either here on earth or after death in a state called purgatory before one could go to heaven\(^1\). A purchase of an indulgence in Catholicism absolved and relieved punishment from sins either partially or fully. Normally one would go through Confession to have their sins absolved. This would in turn, shorten the amount of time in purgatory since their sins would be partially or fully absolved when alive before entering purgatory\(^1\). Luther disagreed with the Church, he believed that purchasing indulgences wouldn’t shorten time in purgatory. To address his beliefs and concerns, Luther pinned his Ninety-Five Theses to the church door on October 31, 1517. These short statements challenged what he thought were inconsistencies with the religion and practice of the Church, mainly the sale of indulgences. Luther only intended to address issues of the Church conventionally, through scholarly debate with other professors of theology. However, the theses were swiftly printed and distributed by Hans Lufft of Wittenberg\(^1\). At least 300,000 copies were printed and distributed in total between 1517 and 1520 in all of Europe, including those translated into other
vernacular, or native languages, aside from the original German.\textsuperscript{6} Within a month, all of Germany was aware of the theses. Within three months, all of Europe quickly learned of them\textsuperscript{1}.

Not only did Luther address abuses of the Church and theological errors through his Ninety-Five Theses, he also translated the Bible from its original scholarly Latin language to the German language of the common people\textsuperscript{1}. While there were eighteen other German versions of the bible before, Luther’s translation appealed to speakers of many local German dialects, which had never been done before\textsuperscript{3}. The printing press allowed for Luther to print over 200,000 copies of his German Bible, which allowed for the accessibility and affordability of personal religious texts. Since most household bibles were translated into the common spoken language, this allowed for more people to individually read and analyze the text in the comfort of their own language. Thus, individual thoughts and opinions of the text and the faith could be formed instead of being influenced by the Church. More people could question the practices of the Church if they didn’t line up with the theology of the Bible. However, most common households still didn’t own personal household Bibles, as they were still quite expensive despite Luther’s Bible being a bestseller in the 16th century. The real agents of Protestant Reformation were the mass production of pamphlets, brochures, and flyers with images depicting the Clergy as corrupt and Luther as the Good Shepherd\textsuperscript{4}. The graphic images carried an anti-Clergy message to the illiterate when the re-printings of the Ninety-Five Theses and the German bibles could not.
The mechanized movable type printing press was the technology that made the spread of religious knowledge and revolutionary theological ideas possible to many Europeans. Before Gutenberg, the process of printing was more complex and expensive, only giving those with large amounts of money access to printed materials. With the Gutenberg printing press, printing became more efficient and inexpensive, which allowed for mass production of materials such as Martin Luther’s Ninety-Five Theses, his German Bible, and anti-Catholicism propaganda. While the printing press allowed for increased mass production of printed materials in general and thus increasing literacy, still only a small portion of the population was literate. However, the spread of knowledge and ideas manifested also in graphic illustrations on portable flyers to reach the rest of the illiterate population in ways never before possible, thus making the Gutenberg printing press a disruptive technology. This technology was also partially responsible for the shift in the power from the religious authority to the people, allowing for the Protestant Reformation to happen.

Print and its uses in the History of Science

Print didn’t affect all areas of human culture equally. The scientific community utilized print in similar fashions as the Church; however, print ended up revolutionizing the scientific community in different ways than the Catholic Church.

Since science was considered a subject of high academia and scholarship, it wasn’t a prominent part of many citizens’ daily lives like religion was. The study of science itself was confined to a select few scattered around the globe. As a consequence, the effects of print on the development of science and the general populations were much slower than that of religion, and often not seen until the seventeenth century. Even though the movable type printing press increased the amount of inexpensive scientific books available to both the scientific scholars and the rest of the population, most of the general population didn’t buy the books because the topics were irrelevant or too complex for their understanding. Thus, the main consumers of early scientific material were still
mostly scientific scholars in the immediate years after the innovation of the printing press. The printing press did play a huge role in the Scientific Revolution within the scientific community, which later led to the spread of scientific knowledge to the rest of the general population.

Before the printing press, many professional scientists kept much of their work from publication. When they did publish, it would be handwritten or printed using wooden stamps that easily deteriorated. Mistakes and textual corruptions in publishing scientific reports were extremely prevalent. After the printing press, published works could circulate more easily within the scientific community with fewer errors. This allowed for easier exchange of ideas and discoveries between scientists of geographical and time constraints. Also, the development of movable type metal plates in place of wooden plates made accurate visual information such as diagrams, maps, anatomical drawings and representations of flora and fauna more permanent. Lastly, the printing press encouraged reprinting and distributing of ancient texts by previous scientists for current scientists to access and consult freely.

Major works marking the Scientific Revolution, such as Nicolaus Copernicus’ *De Revolutionibus* and Andreas Vesalius’ *De Humani Corporis Frabrica*, are examples that were greatly affected by the technological advances of printing and publishing at the time.

*Copernicus*’ *De Revolutionibus* revolutionized 2,000 years of scientific concepts by placing the sun in the center of the universe instead of the earth. His claims were backed up with evidence and diagrams just as previous scientific works had done, but he could utilize the printing press to publish his work in both increased quantity and quality. While at first, his work only circulated the scientific community, within the next 100 years, the rest of Europe had heard of his radical ideas. Print not only allowed for Copernicus to publish his work accurately to a mass population both inside and outside his own country, but it also allowed him to access and study the reprinted works of great astronomer Ptolemy about the geocentric universe model from around 100
A.D. freely with his fellow scholars⁴. Without being able to read the earlier scientific works of Ptolemy, it would be most likely that his ideas wouldn’t have been formed the way they did, nor would he have had the ability to disprove the previous dominate theory.

Similarly, Vesalius’ De Humani Corporis Fabrica was the most important work in human anatomical studies for the next 200 years. Thanks to print, he was able to consult reprinted previous works of Roman scientist Galen. Galen only based his work off of animal dissections and sometimes off of surgeries because scientific methods were limited during his time⁶. Unlike his predecessor, Vesalius based his work mostly on human dissection, which lead to more accuracy. His work compiled many precise and detailed images or diagrams of veins, bones, tissues and muscles in the human body never seen before¹. The printing press allowed for mass production of these detailed drawings, which would have taken years to print one copy by other printing processes or a scribe⁸.

Print not only had an effect on the accessibility of current works to both the scientific community and the general population, it also gave rise to the development of modern science methodologies. After the innovation of the Gutenberg printing press, publication became easier and faster. This lead to an information overload much like a simple Google search would cause today. It became harder to determine which scientific works were credible academic studies and which weren’t. One way to tell the difference was through formal committee
evaluation of works. Any new work published wasn’t deemed an actual scientific study unless it was granted formal approval of a committee consisting of various well-known scientists of the scientific society. Most accepted submissions tended to follow a certain pattern, one that is very close to the modern design of scientific inquiry. This could be because writing in that particular format showed academic scholarly status. After being submitted to the committee, the committee would write a review on the paper, ultimately determining its validity. The same tradition continues today. Peer-reviewed articles of primary scientific articles circulate as much if not more than primary scientific studies in modern scientific journals.

Another way to organize the sudden influx of scientific literature was to sort it into larger volumes. These larger volumes soon became regularly published scientific journals that included a variety of scientific writings. Each included both original primary works and peer-reviewed articles. Journals sped up circulation of scientific news and enabled scientists of different geographic regions to keep tabs the work of their foreign colleagues. Every aspiring scientist soon wrote their works in similar format to those already published if they wanted any chance at publication. This periodic publication is viewed as a further extension and standardization of scientific reporting.

Print didn’t shift the power from the elite to the common people in the science sector as it did in religion. It did, however, allow for an increase in the spread of knowledge and discoveries to both the scientific community and the general public through scientific journals and other published works of scientific inquiry. Without the printing press, great works such as Nicolaus Copernicus’ *De Revolutionibus* and Andreas Vesalius’ *De Humani Corporis Fabrica*, wouldn’t have been written, circulated to wider audience and allowed

In 1665, *Philosophical Transactions* was one of the first scientific journals. Another scientific journal that came out concurrently was *Journal des Scavans*. 
for the Scientific Revolution to take place the way it did; making the printing press a disruptive technology in more than one area of our lives.

**Change in Language Standards**

Gutenberg’s movable type printing press may have affected the scientific and religious communities in numerous different ways, but it also affected both in a few similar ways. One such example is the change of standard print language from Latin to vernacular, or native, languages. This languages included Spanish, French, German, and English among others at the time. In Europe, Latin was the official language of science, the Church, and the monarchy. Latin was known as the language of the educated elite. The language’s connection to the glorious days of the Roman Empire and its use in classic literature made this language the obvious choice to be the standard language of other academic and dignified pursuits such as scientific and religious study. Reading books specifically was also associated with these elite communities for the purposes of enlightenment and gaining knowledge. Citizens of lower economic and social status often had no free time or energy after a day of labor-intensive work. It wasn’t surprising that 77 percent of all books printed in Europe before 1501 were printed in Latin.

This language connected scholars from all around Europe despite geographical constraints. International academic readers of these topics enjoyed a uniformity among their fellow scholars which set them apart from the general public. However, Gutenberg’s movable type printing press allowed for the development and use of metal stamps of the more common vernacular languages’ unique letters. This soon had a democratizing effect on Europe. More Europeans of lower social and economic status demanded books in their own languages since they could now afford personal copies of scientific works and religious texts. As books became more affordable and accessible with the growing widespread number of printing shops, the idea of equality in accessibility and understanding of knowledge spread throughout spanned Europe as other influential figures, including Italian scientist and astronomer
Galileo Galilei, also began to publish works in their native languages, believing that every citizen should be aware of the progress in the study of science and religion. Although there was much unrest from international readers and scholars when the first bibles or scientific works were printed in vernacular languages, the supremacy of Latin was gradually eroded.

As more scientific and religious works were printed in the vernacular languages, a stronger sense of nationalism and revival of culture arose in many European countries. Every time an elite academic figure published works of high importance, new sense of pride and unity was brought to that figure’s home country as it was believed that the country’s greatness was connected to the importance of the scholars who grew up in that country. Especially in the scientific world, citizens rooted for scientists from their own country to make the next big discovery first. This is much different than before, where scientists kept to themselves and their colleagues, and were more connected to other members of the scientific community through the mutual language of Latin than to their own country. In the religious sector, more people could access and form their own opinions of religious texts, eventually leading to the social change behind the Protestant Reformation. This widespread cultural shift wouldn’t have been possible without Gutenberg’s printing press and the spread of religious and scientific knowledge. The movable type printing press and other concurrent innovations allowed for printed materials to be inexpensively mass produced in good quality. This allowed for printed materials previously available only to elite scholars and important religious figures to be easily accessible to the rest of the general population. Newfound accessibility of printed materials increased literacy and ideas of equality in knowledge, led to the disruption of the standard print language of Latin with individual vernacular languages.

**Printed Materials as Agents of Change**

Gutenberg’s movable type printing press was a disruptive innovation in more ways than one. In addition to making printed materials more accessible, it
allowed for the spread of knowledge both within elite communities, like the Catholic Church and the scientific community, and also to the rest of the general population. It brought about new innovations and ideas that lead to changes in power and standards in both the religious and scientific areas of European culture. These included a shift in religious power from the Church authority to the general population, standardization of scientific reporting, and an influx of new scientific discoveries. Although it may seem like the printing press affected the European science and religious community differently, the changes between the two are actually intricately intertwined. Both scientific and religious works were subject to a language change from Latin to vernacular languages. All of these changes were possible because of the printing press. Even more, it allowed for greater accessibility and spread of all kinds of knowledge throughout a wider population never before seen, bringing about several new social dynamics that will lead to several social revolutions.
References

2. Gutenberg.de, "Gutenberg's Invention" Web (n.d.)

Images

1. Willi Heidelbach, Movable type sorted in a letter case and loaded in a composing stick on top, Creative Commons Attribution-Share Alike 3.0 Unported (2004).
2. Martin Luther nailing his Ninety-Five Theses to his Church’s door in 1517, Flickr Public Domain (1872).
3. Title woodcut of Martin Luther’s 1541 German Bible, Wikimedia Public Domain (1541).
4. “Kissing the Pope’s feet,” Anti-Catholicism propaganda mass produced using a printing press in Germany in 1545, Public Domain (1545).

5. Heliocentric Model Diagram from Nicolaus Copernicus’ *De Revolutionibus* (1543), Public Domain (1543).


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