The Printing Press

Imagine yourself in the days before books. We now take for granted the idea of easy access to multiple sources of stored experience, but printed books were the first medium that brought that concept within reach of ordinary people. Before books, almost all transfer of knowledge was by word of mouth. The only way to learn ideas, stories, or skills was by direct personal contact with somebody who had created them or acquired them from somebody else.

Writing is a means to communicate across space and time. It allows you to read the thoughts of people who died long ago and lived in places you've never seen. With the printing press, writing became a broadcast medium. That is, a printing press can replicate a piece of writing on a large scale so that it may be carried to many people and places at once. This enabled new ideas to spread more rapidly through the culture.

This replication also enabled reliable storage of written material. Since printing creates many copies of a document, it reduces the risk that the material might be lost, corrupted, destroyed, or suppressed. This made it possible to preserve a complete and accurate record of people, ideas, and events. Before the printing press, written material could be propagated only by hand copying by scribes, e.g., in monastic scriptoria. This process was selective and mostly controlled by the Church, and it introduced "drift" that corrupted texts and their authorship through time. The press enabled production of uniform texts for laws, maps, histories, scripture, and the classical writings that survived the Dark Ages. The body of printed writings stored in libraries around the world makes up the collective, cumulative, comprehensive memory of humanity. The emergence of this "human memory" marked the beginning of the modern world.

As a result of these two properties, the printing press emerged as a powerful enabling technology. Its impacts on the development of scholarship, science, and technology were profound. Before Gutenberg, the ideas of "progress" and "advancement" in science and scholarship---ideas that we now take for granted---were not possible. Before printing, ideas were lost and rediscovered at different times and places. The press enabled the creation of widely dispersed scholarly communities whose members systematically refine and build upon ideas and results through generations. Science became a collective human enterprise rather than an individual enterprise. Thus the press was the core technology that gave rise to the Age of Enlightenment.

The century after the introduction of the press saw a steady evolution of basic standards and techniques to organize bodies of knowledge and information. Tabulation, alphabetical order, reference guides, and graded textbooks all emerged into common use in the century after the press. With uniform texts it became possible to index and cross-reference material by page numbers and line numbers, and to cite previous works by author, date, title, and publisher. This made it possible to refine and integrate ideas and texts through time by comparison and commentary. The ideas of citation and peer review are fundamental to scholarly progress.

The press had many other important effects. It gave rise to the idea of content as an industry, based on the idea of intellectual property rights and related concepts such as public domain, copyright, and plagiarism. The legal foundations for patents first began to appear about 1500. Newspapers and periodicals emerged; their subscribers were recognized as communities linked by common interests and ideas although most of their members had never met. The influence of writers and their

communities was easily measured by circulation and sales. Reading was recognized as a solitary leisure activity, and the literary intelligentsia emerged as an important political force. The power of the press was used simultaneously as a decentralizing force to undermine established elite institutions, and as an instrument of mass influence and control through advertising and propaganda.

The real innovation of Gutenberg was its movable and interchangeable type. This presaged by 400 years the development of mass-produced machinery from standard, interchangeable parts. In the mid-19th century, use of similar techniques to manufacture guns and other products in the United States was known as "the American system of manufactures" and was the envy of European industry. In essence, the printing press was the first *reconfigurable* machinery for mass production; that its products were copies of texts and books was incidental to its true novelty. The press was a reconfigurable machine that could easily produce customized goods (e.g., books) in volume, then reconfigured to produce a run of a different book. This seeded development of a machine tool industry that produced standardized parts for assembly into a variety of different products.