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From Gutenberg to gigabytes: Writing machines in historical perspective

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FROM GUTENBERG TO GIGABYTES:
WRITING MACHINES IN HISTORICAL PERSPECTIVE

A Thesis
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
English Composition

by
Richard William Rawnsley
June 1995
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The computer is now a ubiquitous tool in all areas of business, government, and schools. With its phenomenal growth over the past twenty-five years there comes a widespread interest in the computer as a tool for teaching writing. Because most composition computer research focuses primarily on the computer's future potential, little research is performed on the computer's close historical ties to mechanical writing machines. To understand what computer technology promises the teaching of writing, it is important to understand that computers are a link in the evolutionary chain of writing machines which began with the invention of movable type. In particular, computer development is closely tied to the typewriter and the typesetting machine, and computers still bear many physical and electronic similarities.

This thesis looks at the computer as a continuation of writing machine evolution. Because typewriters and typesetters were the most significant writing machines previous to the word processor, this thesis emphasizes how their development contributed to the birth of the computer and influenced its present state of development.

This thesis also compares early educational research performed on the typewriter to contemporary computer research performed on the computer. It demonstrates that the similarities are significant enough to consider when
attempting to interpret composition writing machine inquiry.
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I would be remiss if I did not acknowledge my wife, Luella, who stood by patiently while I attempted to turn this thesis into a career.
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INTRODUCTION

Writing technology has a long and venerable history, and like the rest of humanity's tools, it is the result of thousands of years of experimentation, trial, and error. Writing's long tradition began with primitive tools and, through humanity's inherent innovative spirit and the desire to reduce the labor and costs of recording information, led to today's computerized writing machines. Because writing and writing machines are evolutionary, to understand the qualities that are beneficial to writers and how those qualities may benefit the teaching of writing now and in the future, it is important to understand the historical and social conditions that led to today's writing machines.

Because writing is so closely tied to the recording and dissemination of knowledge, it is also closely linked to humanity's veneration of knowledge, from the sacred to the secular. This close connection to sacred and secular knowledge has led to the veneration of writing machines for both scholarly and commercial reasons. For instance, Gutenberg's invention of movable type is looked upon as one of the West's great inventions primarily because it expanded literacy and knowledge. However, this virtuous quality was not responsible for the invention's success, nor for the design and direction of subsequent mechanical
and electronic innovations. Printing influenced the world because it reduced the time and energy needed to produce multiple texts, regardless of the contents of those texts. Movable type and the letterpress enabled publishing to become a leading industry and economic force.

Contrary to the veneration that the West holds for printing, the events and motivations that resulted in printing innovations were primarily the result of commercial interests. Printing succeeded, not because it made the world a better place, but because it was profitable. Thus, commercial concerns made possible the perpetuation of printing and its altruistic accomplishments. As with all successful machines, the desire to reduce the time and effort needed to perform day-to-day tasks provided the market and the momentum that eventually brought printing technology to its current state of the art.

The veneration for the technology of writing may be doubly so for writers, because the tools that writers use are an integral part of the writing process. The typewriter is another example of the human desire, through tools, to reduce drudgery in the tasks of life. Like printing, the typewriter became a powerful tool for business, commerce and the dissemination of information. As early as the end of the nineteenth century, educators also looked at the typewriter as a means to ease their
workload. These academic investigations continued as late as 1972. Many of the assumptions typewriter researchers made were influenced by the political and social beliefs of the period which included an optimism that the nineteenth century mechanical engineering revolution would reduce the insecurities of life. Educators’ optimism for the typewriter stemmed from the same desire to reduce the drudgeries of everyday life that was a significant motivator for industry, from the production of automobiles to sewing machines. However, the assumptions that typewriter researchers made were also influenced by the political and altruistic aspects of late nineteenth and early twentieth century United States society.

Since the production of the first commercial typewriters, it has been the hope of many educators and researchers that machines can cure the difficulties encountered teaching writing skills. Despite the large body of typewriter research in the classroom and the enthusiasm of educators, the typewriter’s influence on writing classes remained merely a standard of legibility for the presentation of written assignments. Today, despite the results of early typewriter investigations and the positive findings of the research, the typewriter remains a tool of business more than education; skilled writing remains essentially the same as it has always been — hard work.
This study attempts to rectify the disparity between what is expected of writing machines by composition specialists and what is known about the background, history and development of writing machines, from commerce to the classroom. At times, I may seem to paint a dismal picture of educational writing machine inquiry, typewriter and computer, but that is not my intention. My intention is to hold writing machine inquiry up to the light of history and show that easing the physical necessities of writing does not necessarily make writing or the teaching of writing any easier or better, just less laborious. The weakness of early writing machine inquiry resulted, not from inattention to detailed study, but from failure to see how political and social aspirations tainted research results and theory. Many of the weaknesses in today's computer investigations suffer the same maladies which include the assumption that the physical labor of writing is more significant than the intellectual labor of writing, so if one eases the physical labor, the intellectual labor follows.

* * *

This study begins by giving the reader a sort of "reality check" in the form of a broader understanding of the essential nature of writing machines throughout the past 550 years. It explores the relationships between early writing technology and emerging electronic
technologies. It explains the parallel development of the typesetting machine and the typewriter, a relationship that influenced the development of computers and eventually led to computerized word processing. This study not only reviews basic educational research into the typewriter and the classroom, but it also contrasts and compares them to the more contemporary inquiry into computers and composition.

Current clinical and theoretical research regarding the computer and composition is certainly more sophisticated than the parallel typewriter work that began almost a century ago. Many of the errors made back then, could not be made now. However, contemporary researchers appear as prepared to pursue their political and social goals at the expense of the research’s longevity as those early pioneers. One way to best avoid this pitfall is to be aware of, and familiar with, the earlier research.

Undoubtedly the computer has a great deal of value in the classroom, and current research is just beginning to uncover some of those benefits. However, it is important to realize that early research made many of the same claims for the typewriter that those investigating the computer make today. Typewriter researchers tended to design their studies to achieve the very results they sought, and this is true of some of today’s computer inquiry as well. It is important to realize that the typewriter never became a
common classroom tool, despite research efforts and findings, nor did the typewriter ease the burden of teacher or student, beyond legibility. This disparity is important to understand if computer researchers wish to avoid suffering the same obsolescence in their work 25 to 100 years from now.

This study sets a historical framework by which the value of emerging technologies can be seen in the overall context of their development. In so doing, it shows weaknesses in previous research that dealt with earlier emerging technologies. If we understand this history, we can make more intelligent decisions about present writing technology.

As funding for all schools is reduced, class sizes grow, and expectations increase, it becomes even more important to look at all aspects of the profession in a broader perspective. Computers and programs are not cheap, nor is the time needed to train both teachers and students in their proper use. If additional funds are spent to purchase computers to improve education, the research must show that the money is best spent on the machines. Although, for many institutions with growing classrooms and shrinking funds, additional expenditures on computers instead of teachers and tutors appears expedient, educational computer research is still in its infancy and the machine's best uses are still not clear. As teachers
and institutions look for more efficient ways to teach without sacrificing quality education, they need to avoid expedient courses of action that appear to be valuable. Reacting to a rapidly changing economic environment for schools, in 1983 John Warren Stewig, Professor of Education, University of Wisconsin, Milwaukee, wrote about the importance of historical perspective for education in an uncertain and constantly changing social and economic climate:

Historic knowledge can guide us as we change school and college curricula to respond to new conditions. There is no need to reinvent the wheel, if we know the kinds of wheels our professional predecessors rode on. Teachers of all subjects at all levels could avoid reinventing the academic wheel if they were more aware of what has gone before (10)

Conceiving of word processing as a new way of composing or a new way of teaching ignores over five centuries of events leading up to today’s computers and programs. Conceiving of word processing as something remarkably new also invokes the nineteenth century myth that science and technology can define, solve, reduce, and/or control the insecurities and the workload of life. Those who researched the typewriter as an educational tool from the end of the nineteenth century also viewed the typewriter as a remarkable new machine, and they essentially invented a "wheel" of writing machine research that never lived up to its expectations. Along with many
discoveries, they also made many errors. Current research into word processing and computers for teaching writing is in danger of reinventing the same wheel and duplicating the errors of the past. The desire for a panacea for composition woes tended then, and tends now, to skew composition research to justify the use of new technology without adequately supporting research findings with unbiased studies and data.

The typewriter, which was thought of as a revolutionary teaching machine, in time, failed to live up to the expectations of researchers. The teaching of writing appears to be no easier now than 100 years ago, despite the proliferation of typewriters throughout society. Even as personal computers become more prevalent, it is possible that they, too, will not live up to the expectations of researchers. If they do not, it may not be because the machines do not have a place in education, merely that their place was overlooked because researchers desired from them what they could not deliver.
CHAPTER ONE

The Word Processing Tradition

The Transitory Nature of Technology

A cutting-edge technology remains sharp for only a short time before it becomes part of the past, relegated alongside other more primitive and clumsy ways of accomplishing tasks. Despite this, new technologies have a deceptive sense of immediacy that obscures their backgrounds, development, and decrepit futures. Generally, what seems remarkable and new is really the current point of a long line of development—a point that quickly becomes, if not obsolete, archaic. Computers and computer programs are a good example of this obsolescence. The personal computers of 10 years ago cannot compare to the present generation in terms of memory or operating speeds or price. The extended memory of today’s machines alone allow personal computers to run programs that needed main frames in the past. Surely another 10 years will take a similar toll on today’s equipment.

Printing’s Contributions to Computer Word Processing

The fast-paced changes in writing systems that we currently see began over 200 years ago with the inventors’ and investors’ fervor to be the first to market a writing machine and/or a mechanized system for setting type. The
basics of word processing are even older.

The printing and publishing industry has always been quick to utilize new technology. Technology that many modern writers quickly learned to take for granted was made possible and affordable by an evolutionary series of printing and publishing innovations. The standard accoutrements for today’s average writer might consist of a micro-processor, text manipulation programs (word processor), CRT screen, keyboard, and plain paper laser printer. These elements existed for many years in printing and publishing offices before they were commonplace in the writer’s office. Technologically, the writer’s electronic tools are not new, but vastly improved, and much cheaper. Although, for their size, they are faster and more powerful, their most significant feature is their price. Twenty years ago, a properly-trained writer could compose on publishing/typesetting equipment with similar operating speeds and power. But instead of costing a few thousand dollars, the equipment costs exceeded $100,000.

The concept of text manipulation is at least as old as Gutenberg’s invention of movable type, and it has existed in one mechanical form or another since at least 1876 when the first mechanical typewriter was commercially produced. Although word processors appear to be new to most users of the technology, they are not new to older printers and typographers who have used them since the early 1960s.
Machine word processing began in the late nineteenth century with the development of input keyboards and basic off-line storage techniques. Electronic writing began in 1948 when Eastman Kodak filed for a patent on devices that would display characters on a cathode ray tube (CRT) without having to physically create them first (Seybold 18-3). Computer word processing began as early as 1954 when Bafour, Blanchard, and Raymond of France filed for a patent on a machine that would utilize a "special-purpose computer" to manipulate texts input onto punched tape (18-4). By the mid 1960s, development of scanning CRT typesetting devices (the parent of laser printer technology) was well underway. These devices held the information for text and character shapes in computer memory until directly scanned onto photosensitive film by a controlled CRT beam. For the first time, no physical matrix was needed to set type.

Until the early 1970s, computerized word processors used main frame or mini-computers. The use of a microcomputer for word processing in 1973 was one of the first commercial applications of the new technology (18-8).

Defining Writing Machines

The first step in understanding writing machine history is understanding what defines a writing machine. Out of the hundreds of methods humans have invented to
record information, how are writing machines different from other writing tools such as the quill and paper? What do writing machines do that other writing tools cannot?

Whether for good or ill, many computer researchers assert that one of the computer's qualities as a writing machine is its ability to ease the task of text manipulation, in particular, editing and revising (McAllister and Louth throughout; Daiute throughout; Gerrard 96, etc.). Although the ability to ease the labor of revision and editing is an important aspect of writing machines, this expedience is secondary to, and dependent upon, the primary quality that all writing machines must possess: the ability to supply an unlimited supply of symbols for the writer to arrange. Despite the apparent complexity of today's computerized writing machines, this is still the primary function upon which all of the word processor's other functions rely.

Until the development and use of movable type in about 1450 by Johannes Gutenberg, in order to produce a readable text writers had to create each individual character to form their texts (or dictate the information to someone who performed this task for them). But movable type introduced the ability to create texts without the necessity of creating each character one after the other (the typefounder now performed that function), and like handwriting, movable type created a finished text that
Incidental to freeing the writer from having to painstakingly form each character, writing machines generally allow the writer to more easily manipulate texts prior to its final appearance on paper. Direct entry systems such as the typewriter, while appearing to lack this ability, with the use of "cut and paste" techniques, still make revision easier than by hand.

The feature that mechanical typewriters lack that most benefits text manipulation is the creation of some sort of off-line storage of text before its final output. The typewriter is a "direct entry" machine. Its output is created at the time the operator inputs the alpha/numeric characters. "Indirect entry" of text was developed with the invention of movable type, which created an off-line form of text storage in the form of galleys (relatively unformatted text being prepared for printing) and forms (formatted and paginated texts ready for printing). Galleys and forms could be manipulated by replacing or moving sections (or blocks) of type from one position to another, as opposed to completely re-writing or erasing and re-writing portions of the text. Correction of errors was also simplified, because minor changes required minor alterations and did not necessitate re-setting pages.

Simply put, writing machines are different from pen, pencil, quill, burin, brush, chisel, paper, clay, wax
tablet, and stone, because they supply an essentially unlimited supply of letters and/or symbols to the writer without the necessity of the writer creating each individual character, and they generally reproduce texts in a mutable fashion for revision and editing before final output or transmission through electronic media.

Until the development of the typewriter, most writers seldom took advantage of the concept of writing from an unlimited supply of letters. After all, setting type from a typecase required availability of materials (the type) and technical skills (relief type must be read up-side-down and backwards, a feat difficult for some people). However, it was a common practice for printers to compose texts at the typecase rather than compose it in manuscript. Writing by hand was redundant when the material had to be typeset anyway.

Writing machines not only ease the production of letters and words, but more importantly for the writer, they ease the tasks of revision and editing. It is this ability to simplify revision and editing which leads writers away from the typewriter and to the word processor, not input speed or accuracy. Although typewriters seem clumsy at revision compared to word processors, they simplify revision compared to handwriting. Cut and paste, erasure and retyping are still more desirable than reproduction by hand, which requires more physical effort.
An innovation in technology is only useful when it is exploited. No persistent technology is ever attained for altruistic reasons. If there is no economic incentive to keep a technology extant, any technological innovation reaches a stand-still and ceases to exist. Early experiments with movable type in China and Korea are cases in point.

Gutenberg and his contemporaries were not the first to invent movable type. Movable type was used as early as 1041-1049 A.D. Douglas C. McMurtrie, typographer, book designer, and printing historian explains that "[t]he Chinese invention of separate types antedated the experiments of Gutenberg by more than four hundred years. The inventor was Pi Shêng, and his types were made of baked clay and not of metal" (95). Although the East experimented with movable type in many forms, including wood and metal as well as ceramics (96), the practice was eventually abandoned because it was too cumbersome to use with a writing system that incorporated thousands of symbols. While Western movable type requires about 80 to 90 bins in a typecase to hold all upper and lowercase letters as well as spacing material and punctuation, Chinese typecases need thousands of bins. This huge variety of necessary ideograms complicated typesetting, redistribution of type, punch cutting (the making of the
matrices to cast the types), and type founding (the casting of the types). Though the altruistic incentive to preserve the art of typography in China and Korea was great, the art failed to survive because the economic incentive was hampered until more financially feasible methods were developed hundreds of years later. (The plethora of symbols in Oriental languages also complicated the development of typewriters and typesetting machines in those languages.)

Because of writing's importance to the growth of shared knowledge and the preservation of culture, people tend to ignore its dependence upon economic considerations for its preservation. This essential fact has been obscured perhaps most by those benefitting most from printing and writing technologies, from religions, to academics, to the printing industry itself. Religion uses writing to maintain traditions among the faithful, while educational institutions use writing to expand the ever-growing tide of information. Many printers make their livelihoods by serving both. It is writing and printing that maintain the hoards of people who flock to these institutions for answers and guidance, thus perpetuating the institutions financially as well as in spirit. The art and craft of printing is an example of how writing's commercial success has been glossed over for altruistic reasons. In the past, printing was continually touted by
writers and philosophers as a high point in humanity's achievements:

The second part of the history of the world and the arts begins with the invention of printing (Johann Wolfgang Goethe to Johann Christian Lobe 1820 [Goethe Gedenkausgabe, Vol. 23, Zürich 1950, p. 96], in Zapf 20 & 109)

The printer is the friend of intelligence, of thought; he is the friend of liberty, of freedom, of law; indeed, the printer is the friend of every man who is the friend of order — the friend of every man who can read! Of all the inventions, of all the discoveries in science or art, of all the great results in the wonderful progress of mechanical energy and skill, the printer is the only product of civilisation necessary to the existence of free man (Charles Dickens, reprinted in The Life of Charles Dickens by John Forster, London 1928, p. 301, in Zapf 110)

High praise indeed. This pedestal upon which printing is placed tends to obscure the fact that printing, like all developing technologies, was primarily pursued for economic reasons and later adapted to altruistic uses. This is also true for even the most ancient developments of writing technology. Albertine Gaur, Deputy Director of Oriental Collections at the British Library writes in A History of Writing:

Most codified forms of writing using (a varying amount of) phonetic elements developed in capitalistically-orientated societies with a primitive technology: between 4000-3000 BC in the Fertile Crescent, about 2000 BC in the Far East (the very latest discoveries may add another millennium to this date), and perhaps around 1000 BC in Central America. Indeed many of the early documents written in those scripts relate to property. In Mesopotamia, Egypt and the ancient Aegean we come across lists of goods sold,
transferred or received, letters, contracts, administrative accounts and records. . . . Only gradually, and in many cases after a good deal of controversy, does the new codified form of writing replace oral traditions in the field of religious and secular literature (17)

Because writing originally preserved and expedited wealth and power, because wealth and power crave increase, writing evolved to keep up with the demand, becoming more efficient, more accurate, and more easily stored and transported. It was not until after writing technology and techniques were developed that the arts and philosophy utilized them. Altruistic endeavors are the users of technology, not the motivators of technology.

When financial, religious, or political considerations demanded more copies, writing technology naturally accommodated, from improved writing surfaces, to improved writing instruments. In the development of writing technology, the need always precedes the development, thus motivating fertile minds to fill the vacuum. This is not to imply that those at the forefront of innovation have merely financial or political gain in mind, but after they achieve their contribution, it is gain that decides whether or not the innovation succeeds or fails.

The success of writing machines since the invention of movable type requires improvements in the speed or convenience of input and/or text manipulation to be successful. An innovation succeeds only if it improves one
or both of these features, and only then is it incorporated into a new generation of writing machines. Contrary to common belief, Gutenberg's significance to the world of printing was not the printing press. Although the printing press sped up the production of duplicating books, it was movable type which sped up the process of copying manuscripts for printing. Movable type required a typesetter to copy the manuscript only once. All other copies were produced from the typeset master. Until that time, if one wanted to duplicate a text through printing, the text had to be hand cut in either wood or metal. Together, movable type and the screw press were more convenient and less expensive than armies of scribes.

Although Gutenberg was probably the first to apply a screw to a printing press, relief printing existed long before movable type. Gutenberg's primary contribution to printing history was a practical method to make and use movable type. Historian and past Library of Congress librarian Daniel J. Boorstin emphasizes this fact when he writes:

His crucial invention was actually not so much a new way of "printing" as a new way of multiplying the metal type for individual letters. . . . Gutenberg's crucial invention was his specially designed mold for casting precisely similar pieces of type quickly and in large numbers. This was a machine tool — a tool for making the machines (i.e., the type) that did the printing (510-511)

Although the printing of texts from a single carved
form (generally wood) was a common practice in some Asian countries, the idea never gained popularity in Europe. It was left to the inventor of moveable type to make mass production of identical texts feasible and practical in the West.

Gutenberg's motivations for his innovations were, in large part, economic. Certainly he understood the financial possibilities, for he spent a great deal of time attempting to amass funds from investors, and later, even more time involved in litigations against him (510-513).

In the West, printing from movable type was an efficient and cost effective way to reproduce information at a time when a knowledge explosion was taking place during the Renaissance, and Gutenberg's timing was perfect to satisfy an information-hungry world.

**Movable Type and the Basics of All Writing Machines**

The invention of movable type in the West was more than an advance in the duplication of texts; it was also the beginning of mechanical writing. Four hundred and twenty years after Gutenberg's invention Mark Twain remarked in a letter to his brother Orion Clemens that:

> WORKING THE TYPE-WRITER REMINDS ME OF OLD ROBERT BUCHANAN, WHO, YOU REMEMBER, USED TO SET UP ARTICLES AT THE CASE WITHOUT PREVIOUSLY PUTTING THEM IN THE FORM OF MANUSCRIPT. I WAS LOST IN ADMIRATION OF SUCH MARVELOUS INTELLECTUAL CAPACITY (Bliven 61, Romano 12)
From the time of the English printer, William Caxton, to Mark Twain's printing and typesetting mentor, Robert Buchanan, it was not uncommon for printers to serve as authors, editors, and translators. Just like "old Robert Buchanan" many of them circumvented the act of shaping the letters by pen and composed the text at the typecase instead, especially when making small changes to texts already typeset. This method of composition easily carried over to typesetting machines. This circumvention of handwritten copy is the basis of all writing machines, and the concept of writing without pen began with the invention of movable type.

The process used to produce a printing matrix from handset type for duplication by letterpress is conceptually the same as the basic process used by word processors. The recorded material for the computer differs in that it is held electronically until called to be altered or output, whereas the letterpress form is physical. Both forms exist and can be altered and reproduced without the use of pen or paper.

The actual process of composing the text from a typecase is slower than by computer, but the reason for this has nothing to do with the computer processor and everything to do with the method of input — fingers striking keys on a keyboard as opposed to fingers grasping and arranging letters from a case. The computer improves
processing speeds and can quickly manipulate texts and react to texts in various ways according to the program running, whereas in manual typesetting, each function must be performed one-at-a-time with care and concentration of the typographer during the process. In both cases, the data must be input before manipulation of the data can be achieved. Both handsetting type and keyboarding do not require the individual shaping of each letter, and they yield a form that exists prior to impression, and a form that can be altered and reproduced without re-inputting the entire text.

Along with the concept of an unlimited supply of letters, movable type also introduced a new and significant aspect of machine writing (and word processing): off-line storage that can be edited without marring the final copy. With movable type, once a text is typeset, if errors are found or changes need to be made, it is a matter of resetting one portion of the text and correcting the error before printing. After printing, the type can be redistributed into cases and used again, or it can be saved for later reprints and revisions.

The concepts of writing from an inexhaustible supply of letters and auxiliary storage were known to all printers, and although many non-printing writers were familiar with the basics of printing, because of the costs, complexity, and skills required to compose with type, few
authors could use that system for writing. So, the methods of the writer remained essentially the same from the invention of the quill pen until the invention of the first commercially successful typewriter.

**Evolution of the Printing Press and Typesetting**

The method of setting type changed little from 1450 until the beginning of the nineteenth century. In contrast, the end of the eighteenth century saw a major step forward in printing-press construction due to advances made in the techniques of casting metal, "and in the rise of a class of mechanics, the forerunners of the engineers, who were to transform the nineteenth-century industrial scene" (Moran 49). One of the most significant advances was the development of a class of letterpresses that did not require the paper to be dampened before printing. (Like intaglio presses, screw presses required that the paper be dampened so the ink would better adhere to the sheet.) Not having to wet the sheet sped up production speeds by a huge margin. Other machine advances, including the web-fed printing press and inexpensive paper (made from tree pulp instead of more expensive animal organs or fabric fibers), revolutionized printing production by reducing the costs of materials and increasing production speeds even more.

Although the appearance and operation of printing
Presses began to change drastically in the early nineteenth century, there were few, if any, appreciable changes in the methods used to set the type for printing or to write the manuscripts that would eventually be typeset and printed. Although the demand for typesetting increased because of the increase in periodicals, newspapers, and the variety of books printed, publishing houses could only respond by hiring ever larger armies of typographers to get the job done. The increase in published material also created a need to speed up the writing process itself.

Parallel Development of the Typewriter and Typesetter

As the demand for publishing increased, so did the demand for texts to be typeset and published. As publishing houses printed a larger variety of texts, it became clear that whoever automated typesetting would not only make a major contribution to the dissemination of texts, but stood to make a great deal of money as well.

The situation for the typewriter was similar:

[T]he pen was annoyingly slow. An expert penman, trying his best, might be able to write at a rate of thirty words per minute, but most writers were something less than expert. The tedium was bad enough in itself, but after 1840, when Samuel F. B. Morse patented his electric telegraph, it seemed worse. In short order a whole generation of telegraphers had appeared who could understand code a lot faster than they could write it down. Shorthand stenographers were in a similar fix. They could take their notes as quickly as a man could speak, and yet they couldn’t transcribe faster than at a snail’s pace.
Not to mention that handwriting was hard to read, and showed no signs of getting better (Bliven 35)

It became clear that whoever found a way to alleviate the drudgery of writing would benefit society and their own pocketbook every bit as much as the developer of an automated typesetting machine.

**Early Evidence of the Need for Writing Machines**

Early evidence of the need for a writing machine emphasized the commercial promise of such a machine and was recorded in 1647 when Charles I granted a patent to William Petty for a machine which

might be learnt in an hour’s time, and of great advantage to lawyers, scriveners, merchants, scholars, registrars, clerks, etcetera; it saving the labour of examination, discovering or preventing falsification, and performing the business of writing – as with ease and speed – so with privacy (Beeching 3)

Petty’s machine appears to be a sort of pantograph machine for writing with two pens at once (3). It shows an early interest in reducing the labor of writing, and especially copying. It also shows that the primary desire to develop the machine stemmed from commercial reasons and not altruistic ones. Less than 60 years later the first documented typewriter was patented:

A prominent English engineer, Henry Mill, was the first, as far as anybody knows, to think up the basic idea of a typewriter. Queen Anne granted him a Royall Letters Patent on January 7, 1714.

... Mill presumably made a model (Bliven 24)
Despite these early attempts at a writing machine, the technique of writing did not change. Although patents had been granted for a variety of writing and copying machines, it was not until 1873 that Christopher Latham Sholes and his backers demonstrated to Philo Remington, president of a family business making firearms, sewing machines, and farm machinery, what proved to be the first typewriter that could be commercially-produced successfully.

Progress in the development of typesetting machines began considerably later than the typewriter. Although the printing press was continually modified over the 500 years following Gutenberg, the method of setting type remained the same. A punch cutter had to punch the matrices for the type, a founder had to make the type, and a compositor had to hand-set the type from cases. Although handsetting type and printing by letterpress was faster than a scribe, the development of commerce, made possible in large part by mass-produced texts, required faster and faster production times. This could only be accomplished by armies of typographers and more foundries producing type. The problem was finally resolved when Ottmar Mergenthaler unveiled the first commercially viable typesetting machine (the Linotype machine) on July 3, 1886 in the composing room of the Tribune in New York City (Romano 63). The Linotype became the first commercially produced and used typesetting machine.
As with Sholes's "Type-Writer," Mergenthaler's Linotype machine was not so much a new invention as a successful combination of ideas generated by a mechanical evolution that was greatly accelerated during the latter part of the nineteenth century. Mergenthaler's was one of many attempts to mechanize the otherwise meticulous task of setting type. One of these attempts, the Paige Compositor designed by inventor James W. Paige, eventually drove Mark Twain to the lecture circuit to recover his investment losses (82). During that machine's development, Twain wrote to friend and author, William D. Howells in 1889 that he had spent "more than $3,000 a month on it for 44 consecutive months" (Twain 288). Twain, as an experienced printer and typesetter, as well as successful published author, was willing to spend over $132,000 on the machine because he recognized the machine's great commercial potential, not only for the publishing business, but for turning his considerable investment into a considerable profit as well. Unfortunately for Twain, the Paige Compositor was never produced commercially.

Of all the attempts at mechanical typesetting during the last two decades of the nineteenth century, two machines were produced well into the twentieth, Mergenthaler's Linotype and Tolbert Lanston's Monotype.

The Linotype casts lines of type from individual recirculating brass matrices (mats) and recirculating
wedges called space bands. When the operator depresses a key on the machine's keyboard, a single mat drops from the magazine onto a belt which transports it to the position where it is aligned with the other characters to create a single line of type. The wedge-shaped "space bands" are pushed up, spreading the mats to justify the type to the proper line measure. When the line is justified to the operator's satisfaction, a lever is pulled and the justified line is transferred to the casting mechanism. After the line has been cast, the space bands are returned for reuse, and each mat is returned to its individual tube, or "channel," in the magazine via an elevating mechanism and the transfer bar. From the transfer bar, the mats are sorted and stored in a large magazine which contains many channels for this purpose. Each mat has a unique "key" cut into it. A rotating distribution bar moves the mats along the top of the magazine. When a mat encounters the cut in the distribution bar that matches its key, it drops into its proper channel ready for reuse.

The Monotype machine casts lines of type from hot metal as well, but, as its name implies, it casts each character individually. The resulting line of type looks very much like a compositor had set the line from foundry type by hand.

The Monotype system consists of two machines, the keyboard and the casting mechanism. The operator depresses
a key, the keyboard punches the code for the key on a punched tape. The power for the tape puncher is provided by compressed air. As the operator inputs the material, a rotating scale mounted on the keyboard indicates how much space is left on the line being set. By observing the scale, the operator can tell when to end a line and how much extra space is needed between each letter to justify the text. This information is punched on the tape as well. After completion of the inputting process, the tape is placed in the separate casting mechanism which uses compressed air to read the characters from the punched-tape, much like a player piano. The matrices for the type are punched on a square, brass, matrix which is positioned by the machine over the caster. The caster, which changes widths to accommodate the character matrix above it, casts each type individually, including word spaces, until the line is completed. The completed line is removed to a holding area, and the caster begins the next line until the tape runs out.

These are very simple descriptions of extremely complex mechanical devices utilizing hundreds of precision moving parts and weighing hundreds of pounds. So complex, yet reliable was the Linotype that "Thomas Alva Edison referred to the Linotype as the 'Eighth Wonder of the World'" (Romano 104). Although much more temperamental than the Linotype, the Monotype produces an even finer
quality of type and has cast type for many of academia's finest volumes in such publishing houses as the Oxford University Press and the University of California Press.

At this juncture it is important to note that typecasting machine operators and hand compositors make virtually all typographic decisions, including line endings, hyphenation, page breaks, pagination, etc., and the type is set one line at a time. The decision making that is required by typography is so complex that it would not be until the 1950s that machines could be developed that could reliably take over most of these functions.

Two Early Writing Machine Innovations

The industrial revolution began a period of rapid technological development, motivated by profit, that continues today. With the development of various models and styles of typewriters and typesetting machines, the groundwork for all writing machines was completed during this century and the first machines were produced by its conclusion. Many of the basic processes that modern writing machines use were developed at that time including auxiliary storage devices and keyboards to input data. Although the invention of the first digital computer did not occur until the late 1930s (Shelly & Cashman 2.2), two of the primary means by which computers stored information until the release of the floppy disk in the early 1970s

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were being used by the last decade of the nineteenth century: the punched card and punched tape. During the nineteenth century the methods the West used to print, set type, and write changed forever because of "modern" technology.

The Development of the Keyboard

Neither Mergenthaler's Linotype machine nor Sholes's "Type-Writer" were original ideas. They were successful inventions utilizing a variety of inventions from a variety of inventors from a variety of countries. They were developed to fulfill the need to write and reproduce writing more quickly — a motivation that preceded their production by at least 100 years and continues to the present day.

The success of typewriters and typesetting machines lay, in part, with how information was input. They were machines of convenience and efficiency, so the development of an efficient inputting system that did not require too much time to learn, or too much time and energy to operate, was important to their intended function. Because the purpose of both the typewriter and the mechanical typesetter was to be able to perform their respective tasks considerably faster than by traditional methods, the operators had to be able to input information more quickly than had been done by hand. In order to achieve this,
inventors took a hint from the musical keyboard:

When early producers of typewriters first directed their thoughts to a keyboard, they were obsessed with the arrangement of the piano keyboard. . . . People, after all, had been playing pianos for 200 years and remember, the basic principles of the piano have changed very little, and the keyboard remains the same today. It is universally understood in any country throughout the world. Given these simple facts, perhaps it is understandable that those who were striving to make a Writing Machine could not see beyond this musical instrument and its general layout (Beeching 39)

Although some of the mechanics of the musical keyboard could be applied to writing machines, the layout proved to be impractical, leaving inventors to devise their own:

"Early machines showed a vast variety of keyboard arrangements. Some were circular, others had three to eight or ten rows of keys; and some had no shift keys whilst others had one or two" (39). Out of this myriad of keyboards, one keyboard became the standard for most western countries. The keyboard we are most familiar with is referred to as the "QWERTY" for the first six letters at the top left of the keyboard. Despite its ubiquitous persistence, Sholes, the inventor of the QWERTY keyboard, did not design it with ergonomics in mind. The concepts of touch typing, memorizing the keyboard, or typing without looking at the keys were not motivations for QWERTY’s inventor. These innovations were left up to the operators to devise. Sholes was interested in producing a successful writing machine, not advanced typing techniques.
The QWERTY keyboard was an innovation intended to overcome mechanical obstacles Sholes was facing. Sholes originally designed his keyboard with four rows of keys arranged alphabetically, and it only typed uppercase letters. This arrangement proved troublesome. As operators typed, they had a tendency to jam the machine, because they could type faster than the machine could return the typebars to their resting positions. Sholes's solution was a different arrangement of letters:

[Sholes] found that the "ABC" arrangement [of his earlier keyboard] caused his . . . machine to jam when any speed was reached and, realizing the insurmountable technical problems arising from this, which had exhausted both his skill and patience, he cast around for other means of resolving his dilemma. He sought the advice of his brother-in-law who was a schoolmaster and mathematician, and asked him to re-arrange the keyboard so that, on most occasions, the bars would come up from opposite directions and would not clash together and jam the machine.

After many calculations and experiments, Sholes established the existing keyboard on which the first six letters are Q W E R T Y, and departed from all previous alphabetical arrangements. He then proceeded to sell this "QWERTY" arrangement of the keyboard. It was probably one of the biggest confidence tricks of all time — namely the idea that this arrangement of the keyboard was scientific and added speed and efficiency. This, of course, was true of his particular machine, but the idea that the so-called 'scientific arrangement' of the keys was designed to give the minimum movement of the hands was, in fact, completely false! To write almost any word in the English language, a maximum distance has to be covered by the fingers (39-40)

The keyboard used for virtually all English-language computer keyboards is not based upon efficiency for the
operator, but efficiency for a mechanical device designed over 100 years ago.

The QWERTY keyboard became the English language standard as the result of a contest between two expert typists. In 1888, Frank E. McGurrin, "stenographer for the Federal Court in Salt Lake City and a first class typist" (40) issued an open challenge to test his keyboarding prowess. McGurrin taught himself the touch technique using a Remington Model No. 1, very similar to Sholes' original machine. The Model No. 1 had four rows of 11 keys each and was the same basic keyboard layout that is in use today. The Model No. 1 typed only uppercase letters. Because McGurrin memorized the keyboard, he did not need to move his eyes from the copy as he typed.

During the time of McGurrin’s challenge "hunt and peck" schools of typing outnumbered those that advocated 10-finger typing and the memorization of the keyboard. At the time, there were many keyboard arrangements on the market. An adherent of one of these alternate keyboard designs, Louis Taub, convinced that he was the world’s fastest typist, accepted McGurrin’s challenge. Taub used a typewriter made by the Caligraph company. The Caligraph machine had six rows of keys with no shift mechanism. It typed both lower and uppercase letters with one key for each. With six rows of 12 keys each, the keyboard had 72 keys compared to Remington’s 44.
The race was to be in two parts: forty-five minutes of direct dictation and forty-five minutes of copying from an unfamiliar script, and the man with the larger combined total number of words would win. The stake was $500. . . . [McGurrin] won both separate events in addition to the aggregate. Typists all over the country noticed an extraordinary feature of his triumph. He had actually gone faster working from copy than when he had taken dictation (Bliven 114-115).

Along with showing the world the expediency of touch typing, McGurrin inadvertently sold the keyboard that he was using - the same Remington keyboard modified by Sholes's brother-in-law. Because of the contest's worldwide publicity, most manufacturers began to modify their machines to accept the QWERTY layout. Those that did not lost any competitive edge in typewriter sales and production.

Although the QWERTY keyboard became the American standard for typewriters, there were still individuals who felt that there were other designs that could improve operator speed and accuracy. It was not until 1905 that the QWERTY was firmly established as the norm for English language typewriters:

In 1905 a large international meeting was called to establish a standard keyboard once and for all. At that time various keyboards - certainly more efficient than the one devised by Sholes and used today - were put forward as alternatives. The battle raged backwards and forwards. Nobody could agree on what a new keyboard should be, but the biggest opposition came from teachers of typing as it still does today. They wanted things to remain as they were, and they are still reluctant to change their methods and learn all over again (Beeching 41).
It is interesting to note that teachers are as guilty as inventors for the clumsy keyboard we use today.

During the years between 1895 and 1931 there were many improvements in the development of the typewriter and typewriting techniques. In 1895 the top speed of an efficient typist was in the neighborhood of 100 wpm. Contests held in New York and Toronto in 1888 yielded speeds of 95.2 to 98.7 wpm (Bliven 116-118). Through improved technique and machines, speeds increased dramatically over the next 30 years. In 1923 Albert Tangora "did 147 net actual words per minute on his Underwood Model 5" (130). Tangora’s feat was produced on a manual typewriter first produced in 1915 (Beeching 214-215).

Although the QWERTY became the standard for offices and business, it was not the standard for printing and publishing. Typesetting keyboards differed from typewriter keyboards for several reasons. First, the function of a typesetting machine was considerably different from the function of a typewriter as were their mechanical requirements (a typewriter might weigh a few pounds, a Linotype machine weighs over 1,000 pounds). In addition, typesetters need a host of characters not utilized in office and personal correspondence, including fractions, ligatures, diphthongs, and specialized punctuation, including a variety of long dashes, fixed spaces and open
and closed single and double quotation marks.

The Linotype keyboard was a triple keyboard with six horizontal rows of 15 keys each. The lowercase letters were located on the left side, figures and punctuation in the middle and uppercase letters on the right. One keyboarding technique encouraged by manufacturers required that the left hand operate the first two rows of the keyboard, and the right hand roamed the rest of the keyboard for the other characters. This meant that approximately one-fourth of the keyboard was handled by the left hand, leaving the remaining three fourths to be handled by the right hand (Barbour). As with the typewriter, Linotype operators were encouraged to use touch systems to keep their eyes free to observe the copy and the rest of the machine (Intertype Corp. 440). Average typesetting speeds on the Linotype machine ran approximately 20 to 30 words per minute. Mark Barbour, curator of the International Printing Museum in Buena Park, California, explained in a telephone interview that

Forty words per minute would be a very good speed of a good operator per minute. I think if you want to talk about the average operator you are talking about half to two thirds for a good operator (Barbour)

Part of the reason for the discrepancy in speed between typewriter operators and typesetting machine operators was the layout of the keyboards. The much larger typesetting machine keyboards did not allow many common words to be
input from a "home" position such as the typewriter, but required constant "roaming" of the keyboard by both hands. Typesetting machine operators also had more typographic concerns such as justification and the addition of alternate characters not available on the keyboard.

Several keyboard-style typecasting machines were developed after the Linotype. The Intertype was, for all intents and purposes, identical to the Linotype. The Monotype, previously discussed, had a different keyboard. Keyboard operations of the various typecasting machines varied from manufacturer to manufacturer. Barbour explained that there were specific schools set up for teaching operators, mostly by the manufacturers, and keyboarding techniques varied. Also, like the typewriter, there were annual trade competitions to test the speed and accuracy of operators. These contests, still held today, never received the level of international attention paid to typewriter speed contests.

As with the typewriter, virtually all successful typesetting machines utilized a keyboard for input except the Ludlow machine, first marketed in 1911 by the Ludlow Typograph Company (Seybold 18-3). The Ludlow was intended to set larger display type, and type matrices were assembled on a composing stick, similar to handset type, prior to casting. Despite the success of machines like the Linotype and the Monotype, because of advancing technology,
particularly the teletype machine and the computer, printing and publishing eventually adopted the QWERTY as its standard keyboard.

The fact that the QWERTY keyboard arrangement dominates computer as well as typewriter keyboards is not a testament to any ergonomic thought on Christopher Latham Sholes's part, but to the difficulty people encounter when first learning to type and their refusal to change their operating habits for more efficient methods. This difficulty is caused by several aspects of the keyboard: first, touch typing requires very complex and rapid movements of all 10 fingers in conjunction with mental activities that vary with the type of work being performed, from transcription to taking dictation to generative typing (writing first draft material without following other copy). Second, the experience of learning to type is fraught with so much work and frustration that the thought of learning to use another keyboard layout, whether more efficient or not, is repulsive to most typists. So, we are faced with a paradox: For the sake of efficiency, learning even the clumsy QWERTY keyboard is worth the effort, yet few desire to apply the limited effort needed to gain the considerable advantages that learning an even more efficient keyboard arrangement offers.

Despite its clumsiness, the QWERTY keyboard represented a faster method of performing writing tasks.
Besides being faster, it was reasonably accurate, and its various output devices (typewriters, typesetters, teletype machines, etc.) provided universally legible copy. Both typewriters and typesetters needed it if they were going to achieve their objective of speeding up the composing and printing processes. Although the mechanics (and electronics) of the keyboard have been constantly improved, no method of machine input has been devised to replace it.

It is unlikely that current research into alternate methods of inputting data into computers will soon replace the keyboard. Although computer research and development is working on handwriting recognition systems, it is unlikely that they will be much more than a novelty for those with good keyboarding skills. These devices require writing by hand, the very process typewriters were developed to replace in most situations. Voice recognition systems have a great deal of promise for those not wishing to type, but speech recognition systems, while constantly improving, need a great deal more improvement before they replace the speed, efficiency, and accuracy of competent keyboardists.

As is evidenced by the factors contributing to the design of the QWERTY keyboard, the efficiency of their writing machines was the inventors' sole priority. Their objective was to develop machines that would speed up the composition, transcription, and dictation processes —
machines that would sell well – and this they did. As is the case with many machines, the development of efficient operating techniques was left to be puzzled out later by operators and manufacturers.
Auxiliary Storage Systems for Writing Machines

If the mind is thought of as an organic computer, then memory is its auxiliary storage, keeping data ready for recall when it is needed. However, memory has the disadvantage of needing the owner of the memory to be present at the review of the information by other people. Writing overcomes this obstacle. It is separate from the writer so that any information can be reviewed by others regardless of time or location. In this sense the typewriter made no advances over previous forms of writing except that it was quicker and more legible. Although perfected more than 400 years previous to the typewriter, movable type represented something different. Once text was composed (typeset), it could be stored for later printing if needed, exactly reproducing the text. It could also be altered before printing to create successive editions of the same basic texts with revisions. To do this, compositors arranged thousands of individual types and graphic elements to fit the page widths needed for a particular edition. Because lead is very heavy and metal type cannot be scrolled, the types had to be broken up at manageable lengths. This could be the actual length of the page to be printed (called a form), or the types could be
stored in trays (galley pans) at random lengths to be paginated later (called galleys). The forms or galleys were tied with string and stored until needed for printing, revision, or redistribution of the type.

The production of typeset forms and galleys represented several advances over manuscript. There is an advantage to altering the form and not the final text itself. If a revision added or deleted lines of text, the compositor merely shifted lines of text to or from adjacent pages to keep the pages consistent. For revisions, a calligrapher had to contend with the final state of the text. Pages had to be removed and/or added, and if the scribe wished the number of lines on a page to be more or less consistent, words or illuminations had to be added or deleted to make up for the differences. More likely than not, a seriously revised text was completely put to the pen again, producing only one new text at a time. Although tedious, revision with movable type was still more convenient for the printer than calligraphy was for the scribe.

The typewriter and Linotype machine represented important advances in writing and typesetting beyond pen and movable type, but like movable type, they were both essentially direct entry systems: operation of both machines resulted in material being immediately cast or typed. Although the typewriter and Linotype machines could
produce copy at a faster rate than their manual counterparts, revision and editing still required either re-typing text or re-casting a line of type and inserting the type in the form or galley. During revision and editing, movable type was more easily managed because each character was individual. Small corrections could be made within a line without disturbing the rest of the line.

The Evolution of Electronic Memory

One important feature of modern writing machines is their ability to store texts in a form other than the final printed, typed, or typeset form. Today’s writing machines store texts in various types of electronic mediums such as RAM (random access memory) and ROM (read only memory). They also store texts in various types of magnetic memory such as floppy or hard disks and magnetic tape. In addition, newer technologies appear from time to time which either improve the speed and/or accessibility of texts such as the compact disk. Some of these techniques are more flexible than others, but all combine speed with vast storage capabilities that were never possible with calligraphy, movable type, typewriter or Linotype machine. Shortly after Mergenthaler’s release of the Linotype machine, another inventor released a successful typesetting machine which utilized off-line storage techniques similar to contemporary writing machines. This represented one of
two important advances made during the late 1880s toward the development of modern auxiliary storage techniques: the punched card and the punched tape.

The punched card and punched tape were true indirect entry systems. The mechanism that encoded the information on the paper was separate from the machine that read and processed the information. In a direct entry system, as the operator inputs information it is processed. With punched paper systems, the information could be input, but not necessarily processed. Their usefulness lay in their ability to: 1) store large amounts of data in small spaces; 2) allow machines to read and process texts and data much faster than was previously possible; and 3) allow the data to be revised and edited before processing. Information no longer had to be produced in its final form to be recorded. Codes on the paper cards or tapes could represent the data and be later input into the devices which would yield the final product. Also, if revision was necessary, the card or tape could be modified or re-punched before actual processing of the information encoded on them.

Dr. Herman Hollerith developed the punched card during the late 1800s to aid in tabulating the 1890 United States Census (Shelly & Cashman 5.4). Punched cards originally had to be punched by hand using a manual card-punching device. The task of punching cards was later improved when the punching mechanism was combined with a typewriter
keyboard to create the keypunch.

The punched tape is a much earlier development. It was used as early as 1858 when "[Sir Charles] Wheatstone invented a high-speed automatic Morse telegraph, using punched paper tape in transmission" (Yule 539). Later, Tolbert Lanston used punched tape to drive the casting mechanism for his Monotype machine:

In 1885 [Tolbert] Lanston applied for a patent which was granted in 1887 and embodied a unique approach to typesetting – the separation of the keyboarding operation from that of actual typesetting.

Lanston’s keyboard delivered perforated tapes . . . which contained the necessary information for justification of a line of type in addition to the selection of the characters to be cast (Romano 84)

The Monotype keyboard was a large double keyboard with even more keys than the Linotype. The keyboard generated a tape that could be stored for later processing by the casting machine or later revisions could be made by splicing the tape with corrected and/or altered tapes.

Although punched card and punched tape as methods of recording data were originally developed in the areas of accounting and telegraph, other disciplines were quick to utilize their advantages. The punched card became the standard of auxiliary storage for business computing, and the punched tape became the standard auxiliary storage system for typesetting until the introduction of the floppy disk by IBM in 1972 (Shelly & Cashman 5.10). Punched paper
was a primary means of off-line storage for almost 100 years, and is still used in some applications today.

The Merging of Typewriter and Typesetting Machine

During the first quarter of the twentieth century, business and publishing commonly used the off-line storage techniques developed during the mid- and late-nineteenth century. The Monotype machine was used commonly for fine book and some magazine publishing. However, the Monotype was more expensive than linecasting machines such as the Linotype, and it suffered from more mechanical failures. Hence, the more popular machine for general printing and newspaper work was by far the linecaster. The linecaster, however, was still a direct entry machine. Editing of all type had to be performed after the type was set. This would change in 1926 when "Walter W. Morey conceived the idea of operating linecasting machines from punched paper tape, a process to be called TTS or teletypesetting" (Seybold 18-3). In order to realize Morey's idea, linecasters were developed with punch tape readers which would automatically take over some of the operations previously performed by the operator. Teletype machines were modified to accommodate the needs of linecasting machines, and although the keyboard had to be altered to a certain extent, alpha-numerically it remained Sholes's QWERTY style. Teletypesetter perforator units were placed
on the market in 1932 (18-3), and the publishing industry quickly embraced the new machines. The division of labor between the Teletype operator and the casting machine operator proved more efficient for large printing houses such as magazines and newspapers. Inputting data on a teletypesetting unit was much quicker than direct input on a linecasting machine, partly due to the more efficient keyboard, and the perforator units were less expensive than the massive casting units. Because the input and justification information for casting was input indirectly, casting unit operators merely had to feed the tape into the machines and ensure that the machines were operating properly. They no longer had to make typographic decisions. One linecasting machine operator could produce a great deal more type from tape than by hand, and one casting unit could accommodate several TTS operators. Although no typecasting machine had ever been operated with a typewriter-style keyboard, subsequent to the development of TTS, all new typesetter designs utilizing a keyboard utilized the QWERTY layout.

A New Generation of Typesetting Machines

Toward the middle of the twentieth century, the letterpress was displaced by offset printing. Letterpress is a relief printing process which utilizes three-dimensional mirror images, like typewriter keys or rubber
stamps. The production of plates for offset printing is primarily a photographic process which utilizes flat, right-reading surfaces. Because hot type machines such as the Linotype and Monotype were designed for the letterpress, as the letterpress was displaced by offset printing, casting machines were eventually replaced as well. Offset printing brought with it the search for new typesetting technology.

Before a typesetting technology could be developed for offset printing, the industry adapted casting machines to serve the new technology. Because a flat, right-reading image, as opposed to a reversed image in relief is needed for offset printing, the main process of creating type for offset printing from casting machines was the use of a special printing press, the reproduction press. This was a precision hand-operated press that yielded extremely precise images from the type on specially treated paper. The printed images were arranged by cutting and pasting the type and graphics on flat boards (flats) and then photographed to produce the negatives for making the offset printing plates. This process was a temporary measure that allowed the industry to continue the use of existing equipment and stored type galleys limiting capital expenditures. It merely awaited new typesetting technologies to replace it.

The rapidly growing field of electronics proved to be
the path for more efficient ways to produce type for the offset process. Eventually the massive, solid metal typecasting machines with smoldering pots of lead, tin, and antimony began to disappear from printing houses, replaced by electronically-controlled devices which resembled office equipment more than printing equipment.

In the printing industry's early transition from hot metal typesetting to "cold" type, dozens of manufacturers explored basically two different alternatives, impact typesetting and photo-mechanical typesetting. Impact typesetting was performed on machines similar to typewriters. The two most recognizable were the IBM Selectric and the Addressograph Varityper machine. These machines utilized interchangeable font matrices, ribbons and typewriter-style platens. They could be used as direct entry devices like a typewriter or with off-line storage systems (generally magnetic tape). Because of this feature and the fact that the impact typesetting machines were more appropriately office equipment as opposed to print shop equipment, "International Business Machines coined the term word processing in 1964 to describe" (Heim 5) the IBM Selectric. Impact typesetting was relatively inexpensive, so it found a considerable market in smaller in-plant and commercial print shops. Because of its slow speed and font style and size limitations, its use was never as widespread as the second process, photo-mechanical typesetting.
The industry standard, at least for a time, was photomechanical typesetting. Very early versions of machines that could expose film through the use of a photographic matrix were based upon the designs of existing hot metal machines. However, the original hot type design of the machines hampered any real possibility for success in the new technology. New approaches to photo typesetting technology did not come until after World War II:

An operational prototype of the Lumitype (Photon) was demonstrated in 1948. This was the first "second generation" phototypesetter. (That is, the first phototypesetter not derived from the design of an existing hot-metal machine.) It established the basic principles for most such machines: use of a spinning matrix of photographic characters, a strobe lamp to flash the character to be exposed, a lens system to enlarge the character image to the size desired, and a traveling carriage to "lay down" the photographic images across a line of type (Seybold 18-3)

As with the earlier TTS units, a QWERTY-style keyboard operated a punched tape machine which recorded the data. Because of their indirect nature, teletypesetting keyboards were easily adapted to the new technology, and Sholes's QWERTY keyboard survived another generation of printing technology. The punched-tape-encoded data was inserted into a punched tape reader on the separate typesetting unit where it directed the output of the machine.

Photo-mechanical typesetters exposed photo-sensitive film directly using a rotating type matrix and an electronic flash. In this process, a full array of
characters was placed in reverse on an opaque strip or disk. Each character had a counting mark alongside it and as the strip or disk rotated, a photo cell counted the marks and an electronic device, later a computer, kept track of what character was in front of the electronic flash at any given time. Thus the machine could expose the characters, with quick and bright bursts of light through lenses, onto the film. Type styles were altered by changing the spinning matrix and sizes could be altered by changing or moving the lenses. Character escapement (the advance of each character to avoid overlapping characters) was achieved by several methods including moving the matrix, moving the film, or using a traversing mirror to reflect the image on the film.

In order to control the rapidly spinning disks and strips, the typesetting industry became one of the first industries to take advantage of computer technology:

In 1954 a patent application was made in France by Bafour, Blanchard and Raymond. Their system as originally conceived embodied a special-purpose tape-typewriter keyboard with additional keys for function codes, and means for producing correction tapes and merging them before processing in a special-purpose computer, details of which were also specified in the patent. They envisaged that the output would control both automatically operated linecasters and other, more advanced photocomposing machines (18-4).

The use of computers to control the "casting" of the type was complemented by the ability of the computer to quickly control most typographic features, including line endings,
hyphenation and justification, and character escapement.

In 1954 hot metal line casters with and without punched tape readers were still being produced, but the introduction of the computer to typesetting quickly saw the abandonment of hot type by all manufacturers and most of the printing and publishing industry. In 1964 the Linotype Company introduced an innovative hot typesetter that dramatically increased the output speed of the unit (Romano 103), but despite this, the end of the hot type era was at hand, and the momentum of phototypesetting was growing.

After the introduction of the computer to typesetting, writing machine technology progressed at a rapid rate. In 1963 a company by the name of Rocappi was formed to supply computer composition services to the printing and publishing trades. Although composition services were common at the time, no one had attempted to control virtually every aspect of composition with a computer, and no one had attempted to devise a universal system that took virtually any computer generated typographic format and converted it to virtually any output mechanism regardless of operating language. In a brief chronology of the history of modern publishing technology, J. W. Seybold, et al., co-founder of Rocappi, writes of the challenges the new company faced:

There was very little support software, so eventually we had to write our own operating system and our own sort program. Early Rocappi
concepts included: storage of material on magnetic medium for update and revision, generic coding, the ability to drive any output device and any type font/character set combinations without any changes to the text file, integration of text processing and data manipulation (for catalogs, indices and the like), computer pagination via batch programs which provided for manual intervention. Later refinements included output of pages in imposition sequence for easy plate exposure. All software ran on a 20K, 6-bit computer (18-4)

Rocappi was essentially looking for a way to make the wide variety of computerized typesetting systems and operating languages compatible with one another. They were one of the first to attempt the type of compatibility that today's "information super highways" take for granted.

Computer control of various text management functions soon became commonplace for those who could afford the expensive equipment, and a plethora of computer controlled-photo-mechanical typesetters were marketed by many of the same companies who only ten years before were manufacturing line casting and office machines. Intertype Corp. and Mergenthaler Corp. joined companies like IBM, RCA, Addressograph Multigraph, and a handful of then small independent companies in pursuit of, if not the first, the best and most affordable computer-controlled typesetting equipment. The Lumitype and its descendants (named cold typesetters because they did not use hot metal) used teletype or teletype-style machines and keyboards to punch the tape. The paper-tape machines were eventually replaced
by magnetic tape and disk, and with many machines, the keyboards and tape and disk drives were combined with the typesetter itself. The photo-mechanical typesetter completed the merger of typewriter and typesetter and added computer control over the typesetting process creating a form that closely resembles today's word processors.

The Birth of Digital Type

Despite the success of computer-driven photo-mechanical typesetting, by 1964 research was underway to produce photo type in a completely different manner. Where previous phototypesetting methods used some sort of physical object to store type matrices, this research utilized computer-memory to store the type matrices as mathematical equations. Because character shapes are stored as data, they can be managed as data. These are referred to as "soft fonts." Early soft fonts were designed to be output through a system that utilized a CRT (cathode ray tube) beam to scan film. Instead of rotating matrices containing the characters and systems of lenses altering character size, the size of a soft font was altered mathematically by the computer. As the CRT beam scanned positive-developing film, it would turn on and off according to computer instructions leaving only the desired image areas exposed. This research was the beginning of digital typesetting, and as the technology improved, lasers
were used to scan the film as well.

Digital technology aided in the production of phototypesetting machines with higher-quality images at higher production speeds. Digital technology also allowed manufacturers to produce publishing systems which retain all data, type and graphics, within a computer system until it is ready for output directly onto offset plates. With the help of computer-controlled scanning beams, particularly the laser, several expensive intermediary steps such as paste-up, photography, or stripping in negatives, was eliminated. Without these skilled intermediary jobs, editors and input personnel took on the additional jobs of graphic design and typography at many publishing houses.

The ease with which editors and input personnel were able to perform basic design tasks on the new systems was a precursor to the development of desk top publishing. As computers performed more of the work, skilled trades positions were eliminated from the printing process. No longer did someone who wished to publish a variety of material need expensive publishing equipment or expensive and skilled trades people. Editorial and clerical staff took over many basic publishing chores. The ease with which acceptable printed material could be turned out by people relatively unskilled in the printing trades expanded the manufacture and sale of typesetting machines, soft
fonts, and eventually today's word processing programs which are designed more like typesetting systems than their early office precursors.

The Micro-chip Revolution

Of three technological elements responsible for the development of contemporary writing machines — digital typesetting, laser technology, and the shrinking costs of micro-computers — it is the micro-chip which is most responsible for the expansion of word processing into desktop publishing. Shortly after its introduction, the advantages of the micro-chip became apparent to typesetting machine manufacturers. In 1973, less than four years after the microprocessor chip's introduction to the market by Intel Corp. (Shelly & Cashman 2.30), "AKI introduced the first product for this industry [typesetting/printing] (and one of the first in any industry) to be built around a micro-computer: the AKI UltraComp editing and composition terminal" (Seybold 18-8). Micro-processor technology led to drastic reductions the prices of both photo-mechanical and the more expensive digital typesetting systems. Micro-processors also led to greater computer control over typeset material than ever and the eventual abandonment of skilled typographers by the printing and publishing industry for less experienced and less expensive clerical workers who, with the aid of the new computer systems,
could now set adequate type.

The micro-chip also led typesetting manufacturers away from designing typesetting programs dedicated solely to expensive main frame and mini-computers manufactured to their specifications. By necessity, their programs now had to run on any number of micro-computers compatible with specific manufacturers, i.e., IBM or Macintosh. They were no longer so much equipment manufacturers as software producers and distributors. Office word processing programs and typesetting programs merged as technology allowed any personal computer to become a typesetter. By 1980, typesetting was no longer a craft needing skilled craftspeople utilizing specialized, complex, and expensive machinery. While some specialized typesetting equipment was still expensive, much of it entered the domain of the office worker, author, educator, and student, virtually replacing the typewriter and the stand-alone typesetter.

The development of the typewriter (specifically the typewriter keyboard) and the development of typesetting technology served as the basis for all word processing advances. Today’s popular word processing programs are limited variations of even more complex typesetting systems, and the advent of affordable laser printers makes anyone with adequate funds essentially a typesetter (without virtue of the typographer’s background). Though word processing systems require some computer background
and study of the individual programs, they do not require the knowledge and background of printing or typographic technology which was necessary for hot metal technology and early electronic typesetting. Nor do they require a knowledge of traditional typographic principles. Thus, few operators feel the need to study these backgrounds. The lack of knowledge concerning the traditions, history, development, legibility factors and forms of typography naturally gives the false impression that word processing is something very new to culture, when it has been with us in one form or another, in one industry or another, for at least 500 years.

Though it took nearly 500 years for technology to improve upon Gutenberg’s invention, human ingenuity finally automated the typesetting process and changes came fast and furious. "Hot" type’s reign would be over in 70 years, and the reign of photo-mechanical typesetting would last a mere twenty.

The Road to Word Processing

When typesetting adopted the Teletype, it also adopted the teletype keyboard – the basic Sholes’s QWERTY keyboard. All modern word processing owes its beginning and its development to the typewriter and typesetting. Today’s word processors are merely a layperson’s version of typesetting systems developed over the past 100 years, and
the layout of the operator's input device is still Sholes's inefficient QWERTY keyboard. Although writing with off-line storage, manipulating texts, and printing texts on auxiliary devices is new to many writers, printers have done it for at least 100 years.

The original word processors were typesetting machines. The innovations that ended with the development of the computer programs and machines we now associate with word processors all began as typesetting innovations: Laser printers have their roots in the early digital typesetting systems, which in turn were an outgrowth of earlier photo-mechanical typesetters. Word processing functions have their roots with the editing and text manipulation strategies of the punched tape typesetting systems. The methods that word processors use to handle typefaces and graphics were perfected by machines dedicated for use as typesetters.

Because of the financial reward for devising better methods for setting and editing type, inventors of typesetting technology were innovative and quick to see the promise of new developments. Ever since the invention of the Linotype, the financial reward of success has driven a rapid succession of new and better typesetting machines. Word processors are merely one of those developments. Only recently have word processors replaced the typewriter in homes, small offices, and schools, and in many cases they
have replaced the typesetter in business and industry applications. Though relatively new innovations for these places, word processing machines have been with us for over 100 years and the concepts of word processing are as old movable type.

*Practicality and the Development of Word Processing Systems*

The development of word processing stems mainly from commercial needs, not altruism. Writing machines were designed to fulfill the physical necessities of production capabilities, and to fulfill backers’ deadlines. To sell, writing machines must be practical, not perfect. Despite their power or versatility, if they prove to be too difficult for the average employee to operate they will not sell. The design process of the QWERTY keyboard is a prime example. Though a relatively clumsy keyboard layout, it proved to be more practical than a typewriter that constantly jammed its keys as the operator built up speed.

The longevity of the QWERTY keyboard is an example of the importance of practicality to word processing. Although several keyboards designed to improve operator performance were introduced subsequent to Sholes’s design, they failed to get any appreciable market share despite proof of their superiority. The most notable of these ergonomic keyboards is the Dvorak which is presently available for most computer systems. Adherents of the
design insist that it is easier to learn, more accurate and faster to operate:

Dr. August Dvorak, who was professor of Education and Director of Research at the University of Washington in Seattle, devised in 1932, a simplified keyboard, which he claimed would accelerate the speed of typing by about 35 percent. . . . But the simple fact remains that no one buys, or wants these simplified keyboards in spite of their obvious advantages (Beeching 42)

Along with increased typing speeds, studies demonstrate that the Dvorak simplified keyboard through a larger home-row vocabulary (3,000 vs. 100 common words), greater utilization of right-hand keying, more balanced utilization of all fingers of each hand, greater utilization of alternative hand sequences . . . and minimization of awkward systems . . . could be learned in about one-third the time needed to master the qwerty, and offered additional advantages of greater accuracy (approximately half as many errors), higher speeds (by about 15-20%), and reduced fatigue" (Cooper 6)

Despite its obvious advantages, the Dvorak Simplified keyboard, along with the other improved designs, remains relatively obscure and unused. As with the teachers of typing during a meeting to establish a standard keyboard in 1905, business, printing and publishing, and word processing keyboard operators still feel it would be impractical to institute and learn a new keyboard system. So, the use of alternate keyboard systems remains extremely limited.

One consideration writing machine researchers must keep in mind is that other components of writing machines
may suffer the same type of design motivations as the QWERTY keyboard. The QWERTY keyboard can be likened to the American system of measurement. Though the metric system is by far superior, intolerance and mass stubbornness prevents the adoption of a clearly better way of doing things. Although it may be clear to the researcher that a particular aspect of computers and teaching is a better way, it may never be put to common use, just as the Dvorak keyboard may never attain common use.

Until recently, when composition specialists began tackling computer software specifically for teaching writing, writing machines were not designed to be teaching machines at all, and as such, their shortcomings in the classroom should be assessed as carefully as their potential. Computers do have a place in teaching writing, and educators are working to find out what that place may be. However, early educational research into the typewriter indicated many advantages and promises that the machine held for education, but the promise of the typewriter never came to fruition in the classroom. Just as with the typewriter, there is a danger of making assertions about the computer that will not be realized over time.
CHAPTER THREE
Educational Writing Machine Inquiry

Composition Researchers as Visionaries

Writing machines, like many technological inventions, i.e., the automobile, telephone, etc., have the potential to contribute substantially to the nature of culture and society. Christopher Latham Sholes recognized this in his invention shortly before his death in 1890:

"Whatever I may have felt in the early days of the value of the typewriter," he wrote in one of his last letters, "it is obviously a blessing to mankind, and especially to womankind. I am glad I had something to do with it. I builded [sic] wiser than I knew, and the world has the benefit of it." (Romano 15)

Educators also recognize the potential effects of technology on society and the individual. In English, Education, and the Electronic Revolution, published in 1967, Edmund J. Farrell commented on the potential effects, negative and positive, that new electronic technologies have on the future of teaching and society:

In summary, we are in the midst of a revolution which is radically changing the entire society, its production and consumption of goods, its leisure time activities, its institutions — among them education — and its values (10)

Farrell placed the computer at the heart of this electronic revolution:

Although the electronic revolution is occurring because a complex of media — radio, film, television, tape recorder, phonograph and record
among them — have become integral to our lives, the rate of the revolution seems proportional to the production of computers (13).

Farrell’s vision of the computer becoming a central focus of our lives is as accurate as when a Dr. William A. Mowry predicted in 1891 that the typewriter would soon be as common in every home as the domestic sewing machine (Kasson 617). The computer is at the center of today’s electronic revolution, and it has spread to the academy. This new focus on computers gives the impression that the use of writing machines in education is something new. In truth, educators have been interested in writing machines since the introduction of the typewriter, and there is a considerable body of inquiry concerning typewriters and education.

One motivation for writing machine research, past and present, is the search for a way to ease the burden of teaching and learning. Central to this search is a vision of how these machines may be used, and how they may affect the future of teaching, learning, and society.

Though early typewriter researchers appeared aware of the typewriter’s impact on society, their concerns were more immediate: How can it be used to improve classroom instruction? How can it be used to make teachers and students and society more efficient and productive? The bulk of contemporary writing machine inquiry also seeks to assess (or prove) the computer’s value to education and how
best to apply it. However, a great deal of practitioner and philosophical inquiry stresses the social impact of computers as well. These studies aim to discover to what degree and in what fashion the computer will alter the future of education and society. Often they look to the computer to help merge differing social backgrounds that exist in this country and to create a universal culture free of class distinctions. Their hope is that cultural and social hierarchies created by an economy based upon wealth will be eliminated by an economy based upon the near infinite access to information afforded by the computer.

By designing studies and observing typewriters in the classroom, early inquiry attempted to prove the machine’s value to teachers and students. In so doing, researchers made predictions about the future of the typewriter and education. These attempts at prescience in typewriter inquiry were more subdued and limited than those of present computer inquiry. Most clinical and practitioner reports on the typewriter implied, or stated outright, that the typewriter had a bright and certain future in education. In an 1895 article in Education, "The Typewriter A Coming Necessity in Schools," Frank H. Kasson states:

The typewriter is here to stay. It is fast becoming a necessity. Business and newspaper offices cannot do without them. It is only a question of time when they will be in common and constant use in our schools (617).

In 1939 Albert Edward Wiggam reviewed an influential 1929
educational typewriter study and concluded with this statement: "Summing it all up . . . the typewriter can be made a distinct aid to fundamental education, all the way from the kindergarten through the grades, and possibly further" (Wiggam 214). Although the researchers involved were interested in the impact the typewriter would have on society, they seldom made predictions beyond expanded uses in business, commerce, and improving existing educational curricula.

Computer research, especially theoretical work, goes much further in its predictions for the computer, predicting significant changes in the way society perceives knowledge, the way society writes and reads, and more significantly, the way we will teach and learn. Prescience, which in typewriter research was limited to usage of the machines, takes on a more important role for computer research. Jeanne W. Halpern and Sarah Liggett explain why they believe foresight is important to the research in the opening chapter of Computers & Composing: How the New Technologies Are Changing Writing. Drawing upon the conclusion of an October 1982 College English article by Lester Faigley and Thomas Miller, which discussed the types of media "college educated" people utilize for composition, Halpern and Liggett explains the importance of assessing the future directions of electronic media, the computer in particular:
ether for good or bad," Faigley and Miller included, "electronic technology will have long­
ge effects on the nature of writing." What se effects are likely to be and how we, as a fession, can most appropriately respond to them is the question. It is clear, first, that will have to define the elements of technological change most likely to affect the performance of our students. We will also have to formulate questions which address the most invasive changes. And we will have to determine kinds of research and classroom practice that will integrate the new technology into our theory and our pedagogy, while maintaining the humanistic values of our discipline (Halpern & Liggett 3)

Halpern and Liggett acknowledge the computer's ubiquity in all aspects of western society, particularly education. It is not a question of whether the computer will be used in education (it already is), but how best to control its use to make it most beneficial. Therefore, prescience becomes fundamental to the research.

Typewriter researchers felt they were looking at a beneficial machine that would remain relatively fixed in design and operation. As a development of the Industrial Revolution, the typewriter would increase the efficiency of office, print shop, and school. Productivity in schools would increase just as it had in business. Students would be taught more efficiently and become more efficient and productive, and more successful members of society. All would benefit. Computer researchers are not that comfortable with the object of their research; computer innovations occur so quickly that as soon as a device is
placed on shelves for sale it is doomed to be obsolete within months. In order to perform research that will be useful for future students, a certain amount of prescience is necessary, if only to envision the capacity and operative techniques of the machines that students will be using 15 years from now, or even next year. This necessity forces modern writing machine research to attempt to catch-up to technology they cannot see: The reality of computer research requires that clinical researchers must deal with extant technology. Then they must apply their findings to various possible future technologies. Thus, a great deal of contemporary research depends upon foresight. This emphasis on the future of technology tends to result in a tense focus upon the future and away from the past. Thus, the weakness of contemporary research is retrospect, which creates a problem for inquiry. Accurate scientific prediction requires the recognition of patterns, and the accuracy of the predictions is influenced by the amount of data the researcher has to work with. Computer inquiry now looks at a fairly narrow window of time, generally stretching back no further than 30 years. And even when a theorist attempts to utilize the early history of writing technology, it is a mere glance at what is only considered an archaic and dying way of doing something.
The Typewriter as an Object of Inquiry

Around the turn of the century, the typewriter became an important object of research for the fields of psychology, business, and education. Psychologists were interested in the typewriter because it was well-suited to clinical study, business professionals because of its ability to streamline office procedures and standardize legibility. Educators were interested in the typewriter because, as writers, they realized that it eased the drudgery of writing and could very likely ease the drudgery of learning and teaching writing as well.

In 1908 the psychologist William Book wrote in The Psychology of Skill that typewriting is well-suited to testing complex motor skills and their acquisition, because it is an extremely complex activity requiring quick mental and physical responses that provides an output that can be readily quantified (Cooper v). These interests in the cognitive aspects of typewriting continued into the 1980s.

Business communities investigated the typewriter for more practical reasons. Much of their work emphasized improving the speed, accuracy, and teaching of typing skills to further enhance the efficiency of the office environment. Because of their efforts, the touch typing system was perfected, and ergonomic improvements were made upon typewriters as well. The adaptation of typesetting devices for the workplace by business machines
manufacturers lead to the eventual acceptance of word processors in other areas such as homes and schools. It is motivation and encouragement by the business community that is responsible for the development of many other input devices including ergonomic keyboards, the "mouse," and the track ball.

Early Educational Writing Machine Inquiry and the Typewriter

The typewriter was the first writing machine to be approached by educators as an aid to teaching writing and other subjects. Although the teaching of composition as a separate field of study is relatively new (beginning about 1963 [North 15]), educational writing machine research began as early as 1895 with Kasson’s article in Education. Early in the typewriter’s development, educators recognized that the typewriter had value beyond vocational applications. Since that time "[o]ver 900 studies have been made . . . that deal in total or in part with the typewriter in classroom instruction" (Sinks & Thurston 344).

The significance of the typewriter became apparent to business professionals soon after its introduction. Within 20 years of its commercial release, it was a mainstay of business and publishing. As writers became familiar with the machine, so did many teachers who thought of its
potential for teaching in the classroom, Kasson among them. His arguments for the use of the typewriter in the classroom were twofold. First, because the typewriter was fast becoming a mainstay in business, it seemed wise to train students in its use to help ensure career success after graduation:

[T]he demand for thorough and practical training for the stern necessities of business life will call upon our youth to fit themselves to do certain things well. The use of the typewriter comes into play at this point (Kasson 617)

Second, after the introduction of the typewriter into classrooms to train students for business careers and to facilitate the teaching of the blind, teachers began to suspect that teaching typewriting skills to the general student population might develop academic skills as well:

No boy can use a machine long without becoming a far better speller. . . . the typewriter leads to more original and better composition work. . . . Here is action. The blood circulates more rapidly. The words emerge clear and clean-cut. . . . And in that alert and roused state of mind, the thought long stagnant begins to flow. To his surprise often, the boy finds that he has thoughts of his own. Having produced his copy, our young writer feels an added interest in having it as perfect in every way as that which he reads in the printed page of his book. . . . Each sentence must not only be spelled right, but punctuated right. Every comma, dash or period must be in place. The sentence must express his exact thought. This leads him to study carefully what he has written. Adjectives are cut out, adverbs placed in new relations, prepositions and even whole clauses transposed. And many words are replaced by others which add beauty, clearness or strength to the diction (618)

These assertions — meticulous spelling and mechanics,
improved fluency, invention, and revision skills, along with boosted confidence for the young writer – became recurrent themes in many of the typewriter inquiries to follow, and continue in contemporary computerized writing machine inquiry.

After observing children working with typewriters, Kasson and others felt that the interaction between student and typewriter improved students' writing process and product. This approach reflects the desire of educators, past and present, to improve the educational process, not only with improved methods, but with technology as well.

Kasson supports his claims through contemporary testimonials from other educators and students who worked in the classroom with typewriters. Although the emphasis is on product, process is mentioned in a few of the testimonials. One mentions improvement in "quickness of thought" and another of "more careful expression of language" (620). One testimonial claims the typewriter increases fluency by reducing the drudgery of writing and its resulting anxiety: "Another [reason] is that the mind, being relieved of much of the drudgery of writing, gives a larger share of its attention to the substance and form of the sentence" (621). Kasson also asserts that writing with "the typewriter leads to more original and better composition work" (618).

Kasson's article is not an example of the best
practitioner inquiry, for it lacks definite examples or formal inquiry methods, but it is representative of the opinion of educators who later approached the typewriter and felt it was a valuable teaching tool. Kasson's article also exemplifies the development of a style of practitioner lore seeking a technological panacea for compositional woes.

As strong or weak as Kasson's arguments may be, his approach to the typewriter and his findings forecast how the typewriter is viewed by researchers for the next eighty years (not to mention how many will approach the computer one hundred years later).

The Wood and Freeman Study

During the school years of 1929-30 and 1930-31, Ben D. Wood of Columbia University and Frank N. Freeman of the University of Chicago undertook a study entitled "An Experimental Study of the Educational Influences of the Typewriter in the Elementary School Classroom." This study became a benchmark for many of the educational studies of the typewriter over the next forty years, and it influenced computer research as well (Hoot 185 for example). The Wood and Freeman study is also a good example of how inquiry can utilize research to achieve desired results and perpetuate inaccurate findings indefinitely.

By 1929 the typewriter did live up to the commercial
potential that Kasson implies when he writes: "In the steady onward march of civilization the typewriter will become a necessity. Its day has not fully come, but it is coming" (Kasson 622). By 1929 its day had come. Instead of selling 35,000 machines a year, as in 1892, an international typewriter industry was selling millions. By 1929 over 518 different models of typewriters had been built, over 200 of them by U.S. companies (Beeching 226-245). By 1929 business schools and business programs in the public schools were regularly teaching typewriter skills. Wood and Freeman, like Kasson, felt there were advantages to learning typewriter skills beyond professional applications:

We have witnessed in recent years a rapid increase in the use of the typewriter in private life as distinguished from business. This extension of the private use of typewriters immediately suggests to educators the question whether the school should not present the opportunity to all pupils, and not merely to commercial students, to learn the use of the machine.

A second, less obvious but perhaps more important, consideration is the value which the typewriter may have as an instrument in carrying on the various learning activities in the school. It seems quite probable that the acquisition of skill on the typewriter would serve not merely the practical purposes of later life, but would also serve as an efficient tool in achieving the normal and accepted aims of elementary school education (Wood & Freeman vii).

Early typewriter research relied heavily on the typewriter’s commercial successes and the demand for educating students in its use in the schools. The remarks
by Wood and Freeman as well as Kasson show how the familiarity of technology leads to applications far beyond the domain intended by those who develop technology.

The Wood and Freeman study was extremely ambitious in scope. It entailed 51 public and private schools and 419 teachers in 13 cities. Over a two-year period, more than 14,000 students from kindergarten to the sixth grade were involved in the study (6).

The basis for the experiment was the same as the basis of Kasson’s earlier article:

For a number of years psychologists and school people have felt that the rather laborious method of writing by hand might be supplemented by such a mechanical device as the typewriter. It seemed clear to these people that, a priori, there were a number of rather obvious advantages of typewriting as compared with ordinary handwriting. Among these were the simplicity of the muscular coördinations required in typewriting, speed, legibility, and the ease of saving compact typed material.

... The present investigation is therefore organized with this comprehensive problem before it: How will the use of the typewriter by the children in the kindergarten through the sixth grade affect the amount and quality of work which the children do in the various school subjects taught in these grades? (10)

Wood and Freeman underscore an aspect of writing machines that is still of interest to educators today — that of reducing the labor of writing. Writing has always been hard work, and it is only natural to assume that reducing the physical labor of writing will allow more energy to be applied to the intellectual aspects.
In addition to the assumption the authors make concerning the relationship between the reduction of physical labor and the increase in intellectual accomplishment, in the above passage the authors demonstrate a common problem in educational research. The passage concludes with the defining of what the authors felt was the primary problem before them, how the use of the typewriter affects the students' work. Their statement is a little deceiving, because as the reader progresses through the study to its conclusions, it becomes clear that when the authors write "how" they do not mean what qualities of typewriting cause the gains they observe in the experimental group, but to what degree those gains are made over the control group, an entirely different matter. Clearly, if there are observable gains in the experimental group it should be of primary importance to discover not only the degree of gain, but what qualities in the experimental groups experience caused those gains.

Wood and Freeman measured the comparative gains by the experimental typewriter students over the non-typewriter control students by pre- and post-test scores. The final gains were achieved by subtracting the control groups' by-subject test results (listed as percentages of a grade level) from those of the experimental group. The experimental gains were then listed as percentages of a grade level. The first-year results showed the following
gains in the experimental groups: language usage 38 percent; dictation 23 percent; literature 14 percent; paragraph reading and word reading 9 percent. Even more remarkable were the scores in traditionally non-English related subjects: arithmetic computation 31 percent and geography 19 percent (34). Second-year results combined with first year results yielded even greater advances by the typewriter group: language usage 125 percent; dictation 26 percent; literature 50 percent; paragraph reading 53 percent; and word reading 35 percent. As for the non-English subjects, geography showed a 133 percent advantage, arithmetic reasoning, which showed no advantage either way the first year, was 103 percent improved and arithmetic computation was 41 percent improved (50).

Such results are remarkable. However, because of the size of the study and the methodology of the study, there is significant room for error. Some of these mediating factors are directly addressed by the authors: The researchers felt that the second-year results were at least 10 percent overrated "since they represent the difference between twelve months of growth of the Experimental groups and only eight months of growth of the Control groups" (50); In addition, Wood and Freeman suspected that the experimental teachers were superior teachers. "Part of this superiority [of the experimental group] is to be attributed to the superiority of the Experimental teachers,
as indicated by the supervisors' ratings" (180).

In addition, the method of financing this huge study should call forth some healthy skepticism. "[T]wo grants, secured through the Typewriter Educational Research Bureau, from the four principal manufacturers of portable typewriters: Remington Rand Inc.; Royal Typewriter Company; L. C. Smith and Corona Typewriters Inc.; and Underwood Typewriter Company" (v). The four companies contributed equal funds which, according to Albert Edward Wiggam in an appraisal of the study and its results written in 1939, equalled "several hundred thousand dollars" (Wiggam 212). Although funding provided by those who may profit the most, emotionally, financially, or politically does not necessarily influence the results of research, the chances are good that it will.

Despite these factors, many educators subsequently regarded the published results as verifiable proof of the typewriter's value to elementary-aged children. Dozens, if not hundreds of studies followed over the next forty-plus years which either duplicated the Wood and Freeman findings or used their findings as a point of departure for variant studies.

The Wood and Freeman Study Marches On

An early study influenced by the Wood and Freeman study was undertaken during the 1930-31 school year, though
the results were not published until late 1935. "A Study of the Influence of Manuscript Writing and of Typewriting on Children’s Development," by Edith Underwood Conard (relationship to John T. Underwood of the Underwood Typewriter Co. is unclear), reflects the common concern educators had at the time that the use of typewriters would adversely affect handwriting skills. It also demonstrates how researchers, in their zeal to discover what they are looking for, perpetuate prior research findings without passing along the weaknesses which directly impact the validity of those findings.

The study was designed to detect how classroom use of the typewriter affects children's handwriting, and "whether the machine would be a practical tool for young children to handle, and how the use of the machine could be planned" (Conard 256). The study was undertaken in two second, two third, and two fourth grade classes from November 1, 1930 to May 1, 1931. Approximately 150 students were involved, "paired as far as possible on the basis of chronological age and mental age" (257). Tests planned by the author for handwriting and typewriting were given at four intervals during the study period. Handwriting tests were given to all classes and a typing test was additionally given to the control group. The exact nature of these tests is never explained, but it is implied that the tests were some sort of dictation or copying – not tests of composition skills.
This type of study relies upon consistency from group to group under investigation. There are two serious weaknesses in this study which affect that reliability. Although Conard states that the children in the experimental and control groups were paired as closely as possible in chronological and mental age, no account is given as to how this was accomplished (257-258). Also, no account is made of individual social background, and very little information is given as to the control of teaching techniques by the various instructors.

In the section entitled "CONCLUSIONS" Conard makes twelve points, all connected with typing and/or handwriting speed and quality. Because speed and quality of handwriting are beyond the scope of this paper, only two brief statements are necessary: Second grade children apparently had the least gains in writing speed, possibly due to being physically immature (263). However, Conard adds that the speed and quality of third graders' handwriting was increased by the typewriter.

The last entry under "CONCLUSIONS" states, "There was not sufficient data collected on the effect of the typewriting on other subjects to form any definite conclusions," (263) yet Conard repeats mention of the Wood and Freeman study and concludes her study with a statement concerning typewriters that is unsupported by her study, though it corroborates the Wood and Freeman findings:
As a result of the study made by the author it appears that the typewriter is influential in developing the children's creative writing, does not affect handwriting detrimentally but appears to stimulate both quality and speed in handwriting, and has a minor influence on other subject matter (264).

Points two and three concerning handwriting and typing speed and quality are relevant to her study. But, influenced as she appears to be by the Wood and Freeman study, the points concerning enhancement of creative writing skills and "other subject matter in the classroom" are not validated by the evidence she presents. These comments show a strong belief that the typewriter is a valuable teaching tool, despite flawed evidence corroborating it.

Conard's simple, yet inaccurate statement, "As a result of the study made by the author it appears that the typewriter is influential in developing the children's creative writing," like Wood and Freeman, is interpreted by later researchers as a verified result of her study. As these results pass from one generation of studies to another, they become more and more remote from their attendant methodologies, and hence appear more and more accurate.

Wood and Freeman, Conard March On . . . and On, and On

In 1972 Thomas A. Sinks and Jay F. Thurston performed an experiment that was similar in approach and results to
the Wood and Freeman study, though much smaller in scale. Predictably enough, this study reported only the positive aspects of both the Wood and Freeman Study and the Conard study, among others. Referring to the Conard study, Sinks and Thurston write:

Results in reading, language composition, computation, and spelling showed large gains by the experimental typing groups over the control manuscript writing groups (Sinks & Thurston 344)

Conard merely mentioned that the typewriter was an aid to creative writing, with no appreciable gains by the typewriter groups over the manuscript groups in the areas of reading, language composition, computation, or spelling:

Average results obtained in composite scores (spelling, arithmetic, and reading, etc.) and in composition scores show some uniformity in development throughout all groups. Since both the Typewriting and Non-typewriting groups show this uniformity in growth it appears that there was little influence from the experience in typewriting on the work in subject matter (Conard 262)

Clearly Sinks and Thurston did not carefully consider Conard's study or they would not have reported such extravagant claims. They were looking for corroboration, and they found it.

Concerning Woods and Freeman, Sinks and Thurston write:

The results indicated that children who used the typewriter advanced more rapidly in all subject matter in the elementary school than those children who did not use the typewriter (Sinks & Thurston 345)
Although this statement is true of the results Wood and Freeman published, Sinks and Thurston never mention the misgivings that Wood and Freeman had for significant aspects of their study, or any other mediating circumstances.

Throughout Sinks’ and Thurston’s brief review of typewriter research they mention only positive results in the studies they discuss. They mention no mediating factors which might diminish those results. As is the case with many researchers in all fields of inquiry, they sought results that suited their quest for validation, and these studies supplied them. They failed to look seriously at the actual methods that were used to attain those results and judge whether those results were justified. Misinformation is easily perpetuated by those who do not look closely at primary sources.

**Contemporary Clinical Writing Machine Inquiry**

Although the three typewriter studies mentioned here have many weaknesses which detract from their findings, these studies in conjunction with the many hundreds of others reported by Sinks and Thurston, as well as studies performed by psychologists and business specialists, give rise to the possibility that the typewriter is useful as a teaching tool and is well worth looking into. The problem is not the topic (the typewriter) but the lack of
objectivity on the part of those doing the looking. So sure were these researchers that their assumptions were correct they failed to see many other aspects of the typewriter which have significance for education. The typewriter seemed to be the emphasis, and cognitive aspects of skilled typing techniques were largely ignored. Fortunately, clinical methods have improved a great deal since the Woods and Freeman study, and some contemporary researchers take operation skill into account in their inquiries, although they still seem to neglect the cognitive aspects of that skilled operation.

Although the computer is considered by most educators an essential part of the curriculum, it is to the credit of most educational clinical computer inquiry that the researchers do not let their enthusiasm for the machines overcome their objectivity. Many studies conducted over the past 10 years indicate that the computer aids some students in developing their writing skills. These studies also suggest that the computer can hamper other students just as easily. Although many of these researchers appear to be just as enthusiastic about the computer as earlier researchers were for the typewriter, these studies conclude that the computer is a useful teaching tool that must be utilized carefully and under close scrutiny. Although many practitioners imply that the computer eases the burden of learning or teaching writing, these studies imply that
computers can also compound writing problems for some students.

As with the typewriter, alleviation of the drudgeries of writing is a specific example many computer advocates use when touting the use of computers in the writing class. Because the area of revision is repeatedly stressed, it is natural that it be an area of interest to researchers. In May of 1992, Research in the Teaching of English published "The Effects of Revising with a Word Processor on Written Composition" by Elana Joram of the University of Pittsburgh, Earl Woodruff of the University of Toronto, Mary Bryson of the University of British Columbia, and Peter H. Lindsay of the Ontario Institute for Studies in Education. Joram, Woodruff, Bryson, and Lindsay designed their study to see if computers improve the quality of eighth-grade students' writing by easing revision (Joram, Woodruff, Bryson & Lindsay 171). In addition, they also were concerned with the effects of revision upon students with different levels of keyboarding and editing skills (172). Because of "the very small number of students in this experiment and in the various conditions" (189) they admit that their findings are less than conclusive. However, they felt the results were strong enough to report that:

writing technologies such as word processors may help writers generate ideas by supporting brainstorming and prewriting activities. . . .
It [the study] suggests that some student writers may do very well with word processors when they are provided with additional supports such as prompts, and that word processors may be beneficial, even in the absence of such prompts (189)

However, the authors add

that prescribing expert strategies for all novices may not always be successful. Such strategies may be inconsistent with the typical way that many novices behave, or the novices may be unable to take advantage of them because of the way their knowledge base is organized (189)

Despite the fact that some students appear to do well with word processors, other students appear to be confounded by them. According to the authors, this would seem to indicate "that assumptions should not be made about the general benefits of word processing without considering the specific writing and text-editing capabilities of the students under consideration" (190). The authors felt that usefulness of word processors for student writers is related to their experience and facility with operating tasks from keyboarding to text manipulation. They stated that for some students computers may create more demands upon their writing than they can effectively manage and still be productive.

In October of 1992, RTE published "The Effects of Word Processing on Students' Writing Quality and Revision Strategies" by Ronald D. Owston, Sharon Murphy and Herbert H. Wideman of York University. Their study also focuses on the effectiveness of revision by eighth-grade student
writers using word processors. They attempted to see how writing performed on the computer differs from that performed with pen or pencil for eighth-grade writers who are experienced with word processing programs, in particular "the newer, more advanced GUI (graphical user interface) word processors that make use of mice" (Owston, Murphy & Wideman 253). Like the Joram, Woodruff, Bryson, and Lindsay study, their conclusions also imply the necessity to apply computers to classroom situations according to the individual student's abilities:

Students vary in their approach to composing using word processing... students appear to bring their own personal style of working to the word-processing environment. Word processors appear to accommodate to whatever level of editing the user wishes to employ. For some writers, like Barbara, the computer may not make too much difference. For others, like Jay, the computer's capabilities may actually take away from the writing event, given an interfering interest in graphics. Yet writers like Cathy are able to use the capabilities of the computer to their advantage, resulting in the creation of a moderately successful piece of writing (271).

These researchers found good reason to apply the computer in the writing classroom. However, they were reticent to conclude that the computer is a valuable teaching tool in all situations. Quite the contrary, they found that the computer has limited uses among specific students, and they make no claims for subject matter out of the domain of composition.

As can be seen in these two studies concerning the
computer and student revision practices, these researchers recognized not only the beneficial aspects of writing machines in the classroom, but the downside as well, and they reported both. The implication is that the computer is far from a panacea for the teaching and learning of writing. Its usefulness depends upon many factors, including the individual writer's experience and abilities with the machines. Gail E. Hawisher of Illinois State University echoes the call for careful scrutiny when she writes in "The Effects of Word Processing on the Revision Strategies of College Freshmen":

We must be wary, then, of extravagant claims. Those of us who are teachers and researchers of language and writing must continue to explore the relationships among writers, writing, and computers so that we continue to evaluate new tools and methods for the teaching of writing. By examining the effects of a computer on the activity of writing, we can, perhaps, move cautiously toward making technology work for us and our students (158).

Luckily, most current clinical writing machine research has been hesitant to make the type of extravagant claims that the typewriter researchers reported. Recent clinical studies regarding the computer and composition are not glowing testaments to the universal use of the machines in the classroom. Unlike previous typewriter studies, a much greater level of skepticism is applied, and there is a shared concern that statements made concerning the machines and composition be realistic.
Unfortunately, this reticence towards extravagant claims is less visible among other modes of educational inquiry including modes sometimes referred to as philosophic, historic, and practitioner. A brief glance at some of the inquiry in these areas shows that the lessons of objectivity to be learned from the previous typewriter literature are not appreciated.
CHAPTER FOUR
The Motivations of Writing Machine Inquiry

Contemporary Neglect of Early Writing Machine Inquiry

The main motivation for typewriter research by the educational community was to justify its use in the classroom. However, despite the number of studies performed and the consistency of their results, these studies are rarely mentioned in computer research — few, if any, composition researchers concede the importance of the close relationship between the typewriter and word processor.

There are many reasons for the current academic neglect of early writing machine research. One reason has to do with the attitude many modern compositionists hold for the formalistic- and capitalistic-culture-based pedagogy that dominated English curriculum for over half this century and much of the nineteenth century. The concepts of form and canon created a difficult and extremely challenging learning atmosphere for all students, but particularly those students from backgrounds that valued literary forms outside of the accepted academic environments. As contemporary composition changed the pedagogical emphasis of form and canon to an emphasis on writing process and individually-based pedagogy, research and practices tended to ignore the previous period
altogether. What is published about the period, if it is not negative, is usually a brief and general historical review.

Both the past formalistic-based and the present process-based pedagogies are a reflection of perspectives on learning dominated by their respective political and social environments. Modern composition pedagogical theory holds most purely formalist teaching techniques to be ineffective, and even detrimental, and past composition formal theory would probably view today's process orientation as ineffective as well. Specific social, political, and philosophical ideologies were a strong influence on how early researchers approached writing machines in education, and they continue to influence writing machine research today.

A good example of the social and political influence in composition research is how contemporary composition views the typewriter. The age of the typewriter in education — from the late nineteenth century through the 1970s — was a time heavily influenced by the economic momentum of the Industrial Revolution. Inventive technology was producing all manner of devices to ease the burdens of blue collar, white collar and domestic work. An extension of the scientific revolution which began with people like Galileo Galilei, Gottfried Wilhelm von Leibniz, and Isaac Newton, the Industrial Revolution instilled in
the United States the idea that there were few, if any, problems that could not be solved by logic and inventive technology. In addition, the manufacture, distribution, and sales of this inventive technology created unrivaled capitalistic growth in this country. Capitalism was alive and well, not only in the society, but in the schools.

Unlike the educators during the early part of this century, contemporary composition is not so quick to embrace capitalism, and Marxist ideals shape much of the new pedagogy. These newer influences tend to look unfavorably at education’s past, not only for its weaknesses, which are many, but its opposing social, political, economic, and philosophical viewpoints as well. This contemporary social view tends to give the impression that the age of the typewriter was a time of skewed social values and exclusionary practices which, among other things, denied women and non-whites participation in society. Thus the earlier period’s solidly prescriptive approach to teaching composition is seen as being inclusive for mainstream white males and exclusive to all others. Formalistic approaches to composition are therefore viewed as an outgrowth of the dismal social conditions of the time and that contemporary composition philosophy is based upon the means to overcome those problems.

Certainly, many misconceptions were generated and propagated by past formalist pedagogy, and many a basic
writer suffered at the hands of a demanding and insensitive teacher. This condition creates the tendency for contemporary composition teachers and researchers to overlook this period of formalism entirely because of its faults. But not all educators before the 1960s sat, red pen in hand, basking in the satisfaction that they had all the answers. There was, as is now, dissent among the ranks, and there was inquiry.

The formalist-approach and process-approach periods are both times of rising enrollments. The latter part of the nineteenth century marked a time when college and university enrollments were growing and large numbers of students were unprepared to write at university level. As a result, professional debates ensued seeking to improve student writing. Two of the strongest camps were the prescriptionists and the classical rhetoricians. According to Donald Stewart in "Some History Lessons for Composition Teachers," eventually "[t]he doctrine of correctness won the day" (Stewart 17). In modern composition studies, this period is branded the dark age of composition. As a consequence, when current compositionists refer to this era, it is generally in pejorative terms with the assumption that little, if anything positive occurred until the establishment of composition as a separate field. Contrary to this impression, there was a constant dialogue then, as now, and there were those who contended that
prescription was secondary to more important considerations. Stewart describes the results of one of the key battles to control university writing curriculum:

Complicating events of the time were three reports by the Committee on Composition to the Harvard Board of Overseers, in 1892, 1895, and 1897. In essence, they were an indictment of the secondary schools for failing to teach college-bound students to spell, punctuate, and observe priorities of usage. Their influence, coupled with that of the Harvard program, one created by A. S. Hill, who was obsessed with these mechanical matters, nullified the efforts of men like Fred Newton Scott of Michigan who sought ways of determining what was still valid in the ancient tradition of rhetoric and of adapting those findings to the teaching of writing in his era (17).

Although the prescriptionists dominated the same period as typewriter research, other approaches existed, including the rhetorical, and these also influenced educational research.

The Political Motives

As new technologies arise, older technologies subside. Because of this evolutionary obsolescence, at any point in the history of writing, the state-of-the-art of writing and duplication appears technologically superior to those of the past. This applies equally to the early uses of animal organs and papers as writing surfaces, movable type, the typewriter, or the computer. Today’s new and remarkable technologies are tomorrow’s archaic novelties. However, it does not follow that with the advent of new technology, old
technology is, or should be abandoned or forgotten. There is much to learn from the past, and rigorous maintenance of past knowledge is important to the present and the future.

Unlike the business community's research and development, early writing machine research was motivated, not so much by financial profit, as by emotional and professional profit. Many educators felt that writing machines improved the teaching and learning process. Their positive views on the machine not only brought the typewriter to the forefront of clinical research, but oftentimes distorted the results of that research. Behind this desire to see the typewriter succeed as a teaching tool was the fact that the typewriter also reflected the then current political and social beliefs that the manufacturing industry, while making a profit, could improve the lives of individuals. Typewriters developed as a result of the Industrial Revolution's gains in technology and manufacturing techniques, and it was a time when mechanical devices were easing the burdens of many physical tasks. Teachers naturally looked at the typewriter with the same expectations about teaching.

Frank H. Kasson's study, one of the earliest publications concerning writing machines and education, is a good overview of what researchers have hoped for writing machines in the classroom over the past 100 years. The article reflects the spirit of the industrial revolution
and the forces that drove the inventors of that century, including Sholes, Mergenthaler, and their contemporaries. It reflects the emphasis on product that was part of the period’s theory base. It also reflects the parallel spirit of the electronics revolution that drive the inventors and educators of the latter part of the twentieth century. Despite the emphasis on mechanical devices of Kasson’s time and the emphasis on electronics in ours, his concept of technology’s place in his world is not all that different from ours:

Ours is a money-making age. Men make fortunes swiftly and often lose them in a day. This high pressure speed exhausts the life forces. Young men grow prematurely old. In such an age every device to save labor and thought is hailed with delight. No wonder it is the age of invention. The age imperiously demands new inventions. And the demand is met (Kasson 615)

Kasson’s comments here reflect a fast-paced society hell-bent for profit. It also reflects an appreciation for technological advances which speed up the processing of information so that profit margins can be more easily maintained at less of a loss to the individual. These two aspects of modern society were at the heart of writing machine development and continue today with the development of faster and more powerful computers. Despite the many misgivings that may be attributed to this attitude, this attitude is responsible for the development of printing technology, the typewriter, the typesetting machine, the
computer, and electronic word processing systems.

Kasson viewed his technological society as a remarkable breakthrough — different from anything that had gone before — and how technological wonders would improve the lot of humanity:

Could Benjamin Franklin walk again the streets of Boston or Philadelphia, what strange sensations would be his comparing old things with new, [sic] The age of steam and electricity would cause astonished or even alarm at every turn. Would he not exclaim as he surveyed man’s works: "All things are new and wonderful!" How eagerly would he examine the steamship, the railway engine, the electric car, the telegraph, the newspaper, the incandescent light, the repeating rifle, the torpedo, the phonograph, the elevator in some lofty building, the stove, the lamp, the furnace, the sewing machine, the piano and the thousand things which add to the beauty, convenience and utility of modern life. Certainly life is very different now from what it was a century ago (615)

"Certainly life is very different now from what it was a century ago!!" Kasson was as impressed with the mechanical revolution of his age as educators are now with the electronic revolution of our age. Kasson’s steam ships, fueled with tons of fossil fuels and wood have been replaced with steam ships fueled by mere pounds of radioactive material, his steam-operated railway engine replaced by powerful diesel electric engines and the bullet train, his electric car is, after a hiatus, once again being produced, his telegraph replaced by telephone, and his newspaper, if not replaced, is augmented by computerized information networks. Kasson was convinced
100 years ago that, because of technology, educators were on the cusp of a new era in teaching, and so too, are many of today’s educators. His conviction led him to believe that the typewriter would make remarkable changes in the way teachers teach and the way students learn.

A brief look at contemporary writing machine research shows that many researchers and practitioners feel that they are also on the cusp of a new era of teaching, and an era of writing and thinking as well. Cynthia L. Selfe touches on this in the first chapter of the book she co-edited with Gail E. Hawisher, Critical Perspectives on Computers and Composition Instruction. Selfe carefully explains that computers alter radically the reader’s and writer’s perception of text:

First, computers add several new grammars to the lists of things that individuals must learn before they become successfully literate in a computer-supported communication environment. We can posit grammars associated with computer keyboards and with computer screens, grammars connected with computer systems or with word processing packages, and grammars related to the use of computer networks or printers. These new kinds of literacy are layered over and have a substantial impact on the tasks of reading and writing. Second, computers change the way we "see" text and construct meaning from written texts. Like the concepts of "indexing" and "zooming-in," some of the conventions associated with computers do not exist in the natural world, and these conventions change the way in which we think about communications problems (Selfe in Hawisher & Selfe 6)

The implication here is that the knowledge required to write by pen or pencil is limited. However, the computer
requires a large vocabulary of computer-oriented concepts, codes, and routines before writing can begin. These new layered grammars, according to Selfe, "must change the ways . . . [we] read, write, and make meaning from written text" (8). (Unfortunately for composition teachers, all writing technology is complicated by unique "grammars." The quill pen also had its required operative necessities that now seem limited but, at the time, required attention and special skills [such as choosing the correct quill and continuous shaping of the tip as well as careful application of ink]. The typewriter also complicated writing by requiring different skills, but typewriter researchers never felt this to be an alteration of how we write, and never thought of them as operative grammars.)

Selfe also discusses what many researchers feel is the critical difference between computer writing and earlier machine and manual writing: the computer screen. Where paper, pen, ink, type, etc., are physical and fixed, text on a computer screen is electronic and fluid:

[Pages are static structural units of a longer, spatially represented text; the text on a page does not change with time. Screens do not represent structural units of a text; rather, they are temporal windows on a virtual text. Virtual texts, unless they are translated into the print medium, exist only in the memories of the computer, the reader, or the writer (7)

The re-creation of a memory-based literacy may be implied from Selfe's argument. That is, a culture where
knowledge is stored, not in texts, but digitally encoded in computers or in the minds of computer operators. In *Writing and Computers*, Colette Daiute takes this one step further. She concludes her book with an anecdote of what writing in the future may be like: Two children are instructing a computer to create a Halloween party invitation. The process requires their attention on the computer screen and voice commands. After verbally inputting the text of the invitation, the children request that the computer do some research of Halloween history to add to the invitation. The computer also reviews and displays graphic images which they choose and verbally instruct the computer to add to the invitation. The children finish by verbally instructing the computer to "send" the invitation to all the children on the block, personalizing each one.

Two children in dirty sneakers had control over a powerful machine. The computer took over the physical activities of writing, and the children expressed themselves as well as they could. The computer also gave them tools for creating a text together relatively easily, which — most importantly — doubled their power as writers, creators, and thinkers. The subject wasn't of great importance, but the collaborative process they used is one of the most interesting ways for writers to work (295).

Daiute’s view is a plausible one. Like Kasson’s typewriter, the computer reduced the drudgery of writing, and the computer performed all the research, reducing the children’s need to spend more than a few attentive minutes
before they could resume play. (As Daiute implied, the
computer doubled their power as writers and creators.
However, this example does not demonstrate an increase in
their power as thinkers.) This example implies that
through the computer, reading and physically writing become
secondary to speaking, not unlike the period preceding, and
up to, Plato’s Socrates. In fact, one could take Daiute’s
vision one step further. The computer generates an audio-
visual invitation that contains no written text. Thus, the
ability to read and physically write extended texts would
no longer be necessary (barring an unfortunate power loss),
just an attention span long enough to complete each task.

Daiute’s view of Halloween invitations is shared by
many computer researchers. Among them, Jay David Bolter,
author of Writing Space: The Computer, Hypertext, and the
History of Writing. Commonly, this sort of inquiry
envision the future as a time with few printed texts.
Virtual texts which exist in computer memories predominate,
and due to their fluid quality, and the ability of the
computer to jump to any portion of the text almost
instantaneously, these texts lack fixed order:

An electronic text is a network rather than the
straight line suggested by the pages of a printed
book, and the network should be available for
reading in a variety of orders. Texts written
explicitly for this new medium will probably
favor short, concentrated expression, because
each unit may be approached from a different
perspective with each reading. Electronic
writing will probably be aphoristic rather than
periodic. A printed book, on the other hand, usually demands a periodic rhetoric, a rhetoric of subordinations and transitions (Bolter ix)

This "aphoristic" quality more resembles a music video with cascades of loosely-related images. Along with aspects of television and cinema, some literature has already taken steps in this direction and many newspapers now favor short stories with no "jumps" over longer stories which may contain a more concise coverage and broader scope, but require more time and effort to read.

Bolter's vision reflects a time when information is equally accessed by all according to his or her own interpretation. It is also a social vision where hierarchy is eliminated by technology. Kasson's vision is a capitalistic vision that reflects his society's desire to see technology ease the drudgeries of life, improve production, and raise living standards. It also reflects the accepted vision of product over process. His vision is of the typewriter making teaching easier. The new vision is much deeper and reflects new critical theories that imply that the writer's product does not have a fixed meaning, but that the meaning is created by the reader in accordance with the reader's personal experience.

According to Bolter, texts will no longer be written or read in a roughly linear fashion. On-screen textual cues will prompt readers to jump to radically different portions of the text, or to entirely different texts. There will be
no such thing as an accurate or even similar reading. Each reading will be random according to the reader's interests and whims at the time. This randomness, coupled with virtually every person being part of a greater information network created by the linking of computers, according to Bolter, creates a new literacy that is no longer culture specific, but network specific:

From this perspective, cultural literacy does not require a knowledge of traditional texts; instead, it means access to the vocabulary needed to read and write effectively. And in fact this operational definition is now making cultural literacy almost synonymous with computer literacy. Both cultural and computer literacy simply mean access to information and the ability to add to the store of information. . . . By this measure traditional scholars, who are at home in the world of printed books and conventional libraries, are relatively illiterate: they may not know how to work their way through an electronic network of information, certainly not how to write electronically for a contemporary audience (237).

For Bolter, the future of literacy is computer literacy, and computer literacy is the exchange of information free of the burden of cultural specificity. The objective of literacy will alter from assimilation, evaluation, and incorporation of information and its distribution into the culture, to the location, manipulation, and re-distribution of information. The concept of knowledge will alter radically. The old concept of knowledge, which carries with it the implication of truth, will cease to be important. It will no longer be necessary for the student
to assimilate knowledge and reconcile it with a specific
culture or community. Because texts are not fixed, there
can be no fixed meanings, and no absolute truths.
Knowledge will instead become data, not to be understood
within the framework of society, but managed within the
framework of the individual at a given space and time.
Because the knowledge "data" base will encompass a
gargantuan volume of information, and that information will
be accessed in a random, rather than linear and fixed
fashion, the individual's influence will be relatively
small, but a larger percentage of the population will be
able to contribute to that data base. Single texts will
cease to have the impact that they have in the past:

[T]he idea and the ideal of the book will change:
print will no longer define the organization and
presentation of knowledge, as it has for the past
five centuries . . . Electronic writing
emphasizes the impermanence and changeability of
text, and it tends to reduce the distance between
author and reader by turning the reader into an
author (2-3)

Following this line of reasoning, computers will not only
change the way we teach and learn, they will change the way
we think, and our conception of truth. It is an
interesting possibility: Society shapes its citizens, and
citizens shape the tools that eventually reshape the
society. It could be prophecy. However, we witnessed a
similar extravagance in the 1895 predictions of Frank
Kasson when he insisted that the typewriter create a new
era in education:

The boy or girl who has had five years experience with a typewriter, other things being equal, will be far ahead of those who have not, in every phase of literary achievement. We, therefore, urge the introduction of the typewriter into our grammar and high schools on purely literary grounds (618-619).

This line of thinking turned out to be wishful thinking in the garb of prophecy. Kasson was seeking a technological solution to teaching difficulties, a solution that also fit his social and political orthodoxy. Despite the fact that the typewriter became a remarkably successful device throughout society, and the advantages Kasson and dozens, perhaps hundreds of educators found in it, it never became a classroom mainstay beyond business science. This desire to see the typewriter achieve with ease what teachers alone achieved with abundant work was a reflection of the social, political, and economic climate of the United States that began with the Industrial Revolution and extended well into the twentieth century – the idea that technological innovations can lessen the burdens of life, and at the same time produce wealth not only for the inventors and factories, but those producing the items as well.

Educators such as Bolter, Daiute, and many others, are also in danger of hiding wishful thinking in the garb of prophecy. Along with their desire to see the computer ease the burdens of the classroom, they also desire to see it achieve their vision of a better social order – the
elimination of social hierarchy, thus easing the task of assimilating students into society-at-large. Theirs is perhaps an even more unreasonable vision of writing machine technology, for it not only alters the classroom, but the basic elements of western society as well.

The realistic assertions made by early writing machine research and contemporary writing machine research are based upon the desire to see technology reduce the drudgery of teaching and thereby aid students in learning. The extravagant assertions by early writing machine research and contemporary writing machine research are echoes of how those making the assertions wish to see the future of society based upon their personal convictions, and not reality.

The Practical Motives

The personal computer began to see common usage during the late 1970s. Today the computer is as commonplace as Wood's and Freeman's typewriter of 1929 or the domestic sewing machine of 1895. Many writers eagerly pushed aside their steel pens and pencils for Remingtons and Underwoods, and more recently they put aside their Remingtons and Underwoods for IBMs and Apples. As naturally as teachers found the advantages of learning to operate a typewriter far outweighed the effort and expenses necessary, teachers today find the advantages of word processing far outweigh
the effort and expense it takes to learn computer skills. As in the past, today’s teachers naturally consider applying the computer to the classroom. Colette Daiute writes in *Writing and Computers*:

> The computer changed writing for me because it helps me revise as much as I want, and it does the recopying. . . . I thought that computers would offer my students tools that would take some of the drudgery out of writing (Daiute v)

Ninety years earlier, Kasson quoted a letter sent to him by another teacher that stated:

> I regard it [the typewriter] as a valuable adjunct in . . . the school or in the home, particularly in the study of English. . . . [T]he mind, being relieved of much of the drudgery of writing, gives a larger share of its attention to the substance and form of the sentence (621)

These similar comments reflect a desire to relieve, not only the drudgery of learning writing skills, but the drudgery of teaching writing skills as well. For at least 100 years, teachers have looked to writing machines to help them in their efforts to teach students to be better writers. Their hopes begin when they realize how much the machines help them in their own professional obligations.

The practical motives for writing machine research are also influenced by political considerations. However, they underlie the pedagogical implications rather than direct them. Just as computer inquiry reflects the values and ideologies of modern composition theory from process to accessibility for non-mainstream students, many of the
assertions and findings made by typewriter researchers reflects their emphasis on product and the quest for excellence. But there is also a concern for process in the typewriter research, as there is a concern for product in the computer research. Both contemporary computer composition research and the early educational typewriter research abound with prescriptive- and process-oriented findings that demonstrate how writing machines ease the labor of writing for students.

Early on an intuition about the writing process was woven into the formalistic comments of educational typewriter research. Kasson’s 1895 practitioner essay is a good example:

No boy can use a machine long without becoming a far better speller. . . . the typewriter leads to more original and better composition work. . . . Here is action. The blood circulates more rapidly. The words emerge clear and clean-cut. . . . And in that alert and roused state of mind, the thought long stagnant begins to flow. To his surprise often, the boy finds that he has thoughts of his own. . . . Having produced his copy, our young writer feels an added interest in having it as perfect in every way as that which he reads in the printed page of his book. . . . Each sentence must not only be spelled right, but punctuated right. Every comma, dash or period must be in place (618).

Kasson’s key phrase is, "Here is action." Clearly, a product cannot be action, but the production process is. Not only did Kasson notice an improvement in product by stating that the writer wanted every sentence punctuated and spelled right, but
[t]he sentence must express his exact thought. This leads him to study carefully what he has written. Adjectives are cut out, adverbs placed in new relations, prepositions and even whole clauses transposed. And many words are replaced by others which add beauty, clearness or strength to the diction (618)

Although Kasson seems to limit these strategies to relatively small areas of student texts, these are still important revision strategies.

Kasson is not alone in his hope that new technology will ease writing labor. The elements of improved spelling, mechanics, fluency, invention skills, and revision skills, plus boosted confidence for the writer are recurrent themes throughout writing machine research. Compare Kasson’s early practitioner comments about the typewriter with these early practitioner comments about word processing:

Any tool that encourages students to properly revise and edit their written work is a welcome addition to the classroom. The word processor is that tool.

While little research about the effects of word processing on students’ writing has been done, teachers report some interesting preliminary findings. They find that students using word processors write longer papers and revise and edit their work more often and more carefully. . . . The overall result is that teachers think their students’ writing is better when it is done on a word processor.

Students uniformly indicate that they like word processing because it’s easier to fix their mistakes and there is no mess on the paper as a result of their editing efforts. They can correct misspellings without crossing out words, and they can wait to write their introduction to an essay or story until after the piece is completed. On a word processor you retype only
those parts of the paper that need to be changed. Parts that are correct don’t need to be retyped. Revising thus becomes true revising, not just the busy work of copying over (Fisher 88)

This material was published in 1983. Glenn Fisher, then computer specialist for the Alameda County, California Office of Education, stresses revision’s importance in this article, but he also states that mechanical considerations are improved as well. Kasson and Fisher approach writing machines in a similar fashion. Differences between generations are sometimes not as extensive as they appear.
The Myopia of Writing Machine Inquiry

The Exclusion of Typewriter Research

For those familiar with writing, it is a rewarding, if not frustrating, exhausting, difficult, and complex task. For those whose writing skills are less adequate, the trying aspects of writing can easily outweigh the rewards. It is not surprising that any machine that is perceived to lessen the drudgery of writing is a welcome addition to the writing classroom. However, much of the research into both typewriters and computers also reflects the desire of educators to use their inquiry to reify the dominant social values influencing academics at the time the inquiry is performed. Because the dominant social values influencing the academy today are directly at odds with those of one hundred years ago, most computer inquiry ignores the hundreds of writing machine studies performed before the computer. This includes inquiry by other fields such as psychology and business, as well as academic. This is unfortunate, because such a volume of research performed on the machine which is closely related to contemporary writing machines is relevant. It is relevant for what was done right as well as what was done wrong, what was scrutinized and what was missed. It is important to understand how this research from the past can aid in
directing and understanding current research, controlling its methods and interpreting its results. It is also important to understand how social, political, and philosophical elements influence research negatively.

**Obstacles to Utilizing Typewriter Research**

As a vehicle for indoctrinating individuals into the more sophisticated aspects of assimilation into society, education is extremely sensitive to, and at times, a leader of social and political change. As accepted social and political beliefs change for what many feel is the best, it creates the impression that teaching theory and technique are constantly moving forward for the betterment of those being educated. How could it be otherwise for those who are sure that they possess the proper means to view society? This was true for the early advocates of formal approaches to teaching writing as well as contemporary process writing pedagogy. This security in one's own techniques is partly responsible for the weaknesses in writing machine inquiry, especially the current neglect of early writing machine research. Particular to the typewriter are the contemporary negative perceptions that: 1) the late nineteenth and early- to mid-twentieth centuries were a barren period for composition studies; 2) the typewriter was a tool which created more boundaries for operators (women) than it afforded opportunities; and 3)
there can be little value in typewriter research, because the typewriter, as a purely mechanical device, cannot be compared to modern computer writing systems and the flexibility that stems from their complexity.

1) The social and political differences between the period of most typewriter research and contemporary computer research has already been discussed at length. It is enough to say here that the pedagogy existing at the time of typewriter research was very much in opposition to the pedagogies directing current writing machine research.

2) A less obvious reason for the obscurity of typewriter inquiry results from the fact that many feminists hold that the typewriter was a tool for subjugation of women in office environments:

[T]he typewriter has become a kind of mechanical appendage to a secretary's body, and if it is not in her way as a physical object, then her proficiency at it (or lack thereof) serves to limit her employment opportunities. Who has not heard the line, 'But can she type?'" (Pinard 26)

The view that the tool which allowed women into the office also denied them a way out is relatively common among some groups of feminist scholars. Today the computer has virtually replaced the typewriter in the office. Although clerical staff are still predominantly women, and their responsibilities remain roughly the same, this negative view of the typewriter has not transferred to the computer with the same intensity, so the typewriter remains the tool
responsible for the abuse of women in the workplace. This negative view of the typewriter implies that the typewriter’s use in the classroom had a negative affect, because it set professional boundaries for women.

3) The most damaging reason for the neglect of typewriter research may not be social or political prejudice but a sort of techno-centricity. Many compositionists consider the typewriter too archaic and simple a device to be of practical use in the classroom beyond the same chores of pen and pencil. Despite the close relationship between typewriter, typesetter, and computer, researchers do not recognize the connection between the typewriter and the word processor. Colette Daiute’s 1985 book, Writing and Computers states, wrongly, that the typewriter was too simplistic to pique the interest of educational researchers:

If the typewriter had just been invented, I think it also would attract attention as a tool that could affect the translation of ideas into written symbols. However, it would seem less interesting because it is not so dynamic. The effects of prior writing technologies like typewriters were probably not studied because, at the time they were invented, research focused on literary analyses of style regardless of the writing method. The effects on our writing will change as developments in hardware and software alter the speed, flexibility, and language-processing power of computers (Daiute 284).

Daiute’s book, though useful for assessing the value of computers in the classroom, is also a good example of the social, political, and techno-centric attitudes that
permeate most contemporary composition and computer inquiry. Whether stated or implied, the attitude that past educators were solely interested in formalistic aspects of student writing is partly responsible for Daiute’s neglect of early typewriter research. First, Daiute views the teaching of writing previous to modern composition as inferior because of the emphasis on product rather than process. She then assumes that because of the differing views of the past, researchers were not interested in the typewriter as part of the writing process, but only as a tool for creating the product. Finally she assumes that the impact of typewriter technology on the late nineteenth and early twentieth centuries was minimal compared to the computer’s current impact in the late twentieth century. The reality is that the formalist approach to the teaching of writing, while in the main, was not the sole approach used by educators. The reality is that the typewriter was of extreme interest to many educators who spent thousands, if not millions of dollars on research. The reality is that the typewriter and the typesetting machine were not just simple tools built by a simple society to perform simple tasks. Late nineteenth and early twentieth century society was as complex as today’s society, and the tasks required of early writing machines were similar to contemporary writing machines: “the translation of ideas into written symbols,” and the dissemination of those ideas
through the symbols generated by the machines and their operators. Contrary to Daiute’s view, the impact that the typewriter and typesetting machine had on United States society was profound. Within twenty years of their first production the ubiquitous presence of both machines forever altered the office, printing and publishing, and the home.

Like Daiute, because of ideological and technological differences, many composition researchers assume there is no significant educational writing machine research before the computer, thereby throwing out an extensive body of work. These limited impressions of the past encourage the view that all early composition theory, practice, and research proved to be ineffective, and that all past achievements are somehow inferior to today’s enlightened approaches. As a result, many compositionists cast the past aside in anticipation of "new," "better," and "more enlightened" approaches. By neglecting an entire body of knowledge because of disagreements with politics and pedagogy and by keeping its research eye fixed only on the future, composition writing machine inquiry is in danger creating an alternate history that does not reflect the important connections to today’s writing machine inquiry. It is also in danger repeating the mendacity and error that is rife within the sincere but biased earlier research.
Inclusion vs. Exclusion

After reading the foregoing it may appear that, because of practical and personal difficulties, because of errors in method or prejudicial findings, a great deal of research should be excluded from study. This of course is not the case. There cannot be such an extensive body of work that does not have benefit. Although much of writing machine research is tainted by personal expectations, there is still value in the information collected and the consistency of many of the findings. There is value in studying the weaknesses of the research as well as its strengths, not because those weaknesses justify new trends in education, but because those weaknesses demonstrate problems in all research.

This thesis is not a call to exclude research for its faults; it is a call to include and acknowledge research despite its faults. The intent is to encourage the composition community to place the history of writing machines and educational, business, and psychological writing machine research on an equal footing with contemporary inquiry into the computer. As this is done, it will become apparent that all research, new and old, needs to be looked at objectively, without the bias of political and pedagogical theory.

Virtually all writing machine research shares a concern for students and the determination to see
technology improve their lives through better education. Students very much need that concern and determination. However, false promises that fit pedagogical or political goals do not help students. And in the long run, as typewriter research demonstrates, false goals do not materialize. The ability to prevent the repetition of inaccurate findings, and the repetition of those findings is one of the primary values of past research. To ignore the past because of intellectual disagreement, or to acknowledge current research merely because of intellectual agreement will, as with the typewriter, doom the research to obscurity despite all promises researchers make.
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