

The Unfinished Revolution of Information

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WHEN did the Information Age begin? Some experts go as far back as the thriving manuscript copying industry of medieval Paris. Many point, more conventionally, to Gutenberg's use of movable type. Others insist that it started only with paper that could be produced continuously rather than sheet-by-sheet in the early nineteenth century (the Fourdrinier process), and still others would hold the title for the era of power presses and mechanical typesetting beginning in the 1880s. My own experience suggests a different answer: the coming of the Xerox 914 in 1963, the first widely available photocopier that could economically make reproductions that were sometimes superior to originals. I have argued in the *Atlantic* that this was a step toward the possibility of universal self-publishing, ultimately electronic; the stencils and ink stains of the mimeograph were soon history.

I remember the Xerox copier's arrival at Princeton. There was still no public machine when I was a senior in 1965, and doing my own typing I had no patience for carbon paper. Firestone Library did not yet have a public photocopier. At the time I was one of two "On the Campus" columnists for the *Princeton Alumni Weekly*, and the editor, John D. Davies '41, kindly gave me permission to use the 914 at Princeton University Press; PAW was edited, typeset, and printed in the Press building at 41 William Street. A week or two later John Davies informed me of a blistering memo written by the press director, Herbert S. Bailey, Jr., on an undergraduate presence as a breach of security. Many examination papers were still composed in hot metal and printed in the building—beautifully, too, often in the ten-point Caslon that was almost a Princeton trademark at the time. (Even examination papers for the handsomely endowed Stinnecke Prize in Classics, a test so rigorous that only two members of our class were said to have attempted it, were type set in the same building in Latin and Greek.) The squall blew over, but it marked a quiet revolution and the beginning of the end for Linotype itself.

Meanwhile, in 1964, a distinguished Russian Orthodox theologian and church historian, Father Georges Florovsky, had arrived on campus. An emeritus professor from Harvard, he was a formidable guru in a black cassock, one of the twentieth century's greatest authorities on Eastern Orthodox theology and spirituality. But, unknown to undergraduates who nicknamed him the Grand Inquisitor, he was more than the embodiment of ancient tradition. To the contrary, once Firestone Library installed a self-service Xerox photocopier, he was its most avid user, according to a recent biography, Paul L. Gavriluk's *Georges Flo-*

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rovsky and the Russian Religious Renaissance. Father Florovsky's picture allegedly was displayed above the machine as a gesture of respect (and perhaps an appeal to divine protection from paper jams?) by the library staff. In the archives of St. Vladimir's Seminary, to which Florovsky donated his papers, there are 62 boxes of entire photocopied books. Xerography may have been the original technological miracle, and it is said that Father Florovsky was the inspiration for the monk in the 1977 Xerox Super Bowl commercial.

By 1972, when I received my Ph.D. from the University of Chicago, an age of information abundance was dawning, or so my contemporaries and I believed. During my fellowship at Harvard in the late 1960s, one of the nation's first copy shops, Gnomon, was already thriving. Copiers were ubiquitous in libraries. The sense of a data flood was growing. The first reference I have found to an "information abundance problem"—note it was already a problem—was in volume 2 of the *Annual Reviews of Information Science and Technology* in 1967. Higher education was still expanding, and the guru Peter Drucker's prophecies about the future prevalence of "knowledge workers" were ascendant in business. Even an aspiring humanist working in a relatively arcane field like early 19th-century German history could hope for a full-time, tenure-track academic job.

I researched my dissertation on the causes of popular revolts in the German states during the early 1830s using file cards with holes and notched edges, sorted by rods like knitting needles, as a database. A year in Germany showed me how advanced American information abundance was. Books published before the 1960s were listed in massive bound volumes smelling like cigar boxes, with strips of paper ordered by author only. Card catalogs were still high tech. The Xerox photocopier, introduced in 1959, and its offspring the instant copy shop (the original copyright pirate cove) remained uncommon in Europe. And the official *kurrentschrift* of archived official documents—a slanted, apparently uniform zigzag designed for rapid writing—remains challenging even to educated Germans today, meticulous as it appears once you've deciphered it.

IN HINDSIGHT I realize that in North America, too, the 1970s were still a time of information scarcity, despite the ubiquity of photocopying. People looked up to a small number of authorities, for better or worse. Newspaper columnists and book reviewers still had formidable clout; their doyen, Walter Lippmann, had retired only in 1967. (Early in the Second World War, a confidential report by Isaiah Berlin to Winston Churchill gave his influence a rare three stars out of four, making him a media outlet in his own right.) The Book-of-the-Month Club still promised the wise selections of a panel of distinguished literary judges. Or you could go to your public library and pore through month after month of the *Book Review Digest*.

The Ph.D. cohort of the early 1970s was the last to climb aboard the tenure track express. When Kierkegaard wrote that life is lived forward but understood backward he could have been referring to my dissertation; I later realized I should have been asking an entirely different set of questions, more along the anthropological lines of David Sabeau's *Power in the Blood* (Cambridge University Press, 1984), but there was no time.

Fortunately, the skills I learned in those creaky catalog volumes and musty files paid off. Among my early jobs was a research assistantship to one of my teachers, William H. McNeill, during the project that became his best-selling *Plagues and Peoples* (Anchor, 1977). Years later when I visited him in retirement, Bill McNeill revealed to me one secret of his scholarly productivity. He never took notes. Even in the early photocopying age, he wrote directly consulting the books and papers he needed. I also edited a paper by Theodore R. Marmor at U. of C.'s Center for Health Administration Studies.

My experience in these jobs led to the next one, as a science book acquisition editor at Princeton University Press, presented a new information challenge. (Evidently Herb Bailey had forgotten the 1965 incident or had never connected me with it by name.) I learned the arcane skills of identifying the small minority of scientists motivated and able to write good books, whether specialized monographs or popular

syntheses. Spies—and I have worked with at least one—call these skills tradecraft. You can't find them in books on publishing, and at least then they were rarely discussed openly. My strategy was simply gathering early information: subscribing to a dozen university bulletins and circling promising lectures; collecting campus telephone books and departmental lists of current grants and research projects. Now universally available, such documents were then still not easy for visitors to find on many campuses.

As a science editor I became an early adopter of e-mail in the late 1980s. As a sister organization of Princeton University, the Press had access to an Internet precursor called BITNET that ran on academic and government mainframes, and I had an account that has long since vanished, along with my correspondence. In 1988 I used it to set up appointments for my visit to Moscow as a guest of the USSR Academy of Sciences. But it was useless for most research, except for advanced scientific collaboration. The first widely used system for document searching on the Internet, Gopher, was not introduced until 1991.

When (coincidentally) I decided to leave publishing for independent writing after receiving a Guggenheim Fellowship, years of coping with scarcity were my friend. I had learned shortcuts in working with the few major end-user databases of the late 1980s; these helped me navigate the flood of data that became available a few years later with the World Wide Web and modern browser. People who have grown up with digital abundance may excel at programming, games, and many other electronic skills, yet (as I discovered when I wrote an article on the subject ten years ago) there are today very few undergraduate power researchers. For at least some of us older users, constraint had sharpened our technique; it was like training wearing weights, or at high altitude. Memory is still important, but it was once essential. Interviewed by John Glick for the *Daily Princetonian* after winning the Stinnecke Prize, John Vigorita had remarked in 1962 that “things just stick in my mind.”

MY WRITING explored unintended consequences. The timing was fortunate: the new web was complementing and amplifying conventional print publications but not yet competing directly with them. For writers and publishers, the web boom of the late 1990s was the best of both worlds, a cornucopia of advertising supporting conventional products, like the excellent *Britannica Yearbooks of Science and the Future* series, to which I contributed essays on futurism. Sadly, thanks to science, those yearbooks had no future.

Other high-quality publications for which I've written—*Civilization*, the *Industry Standard*, and now the *Wilson Quarterly*—are also casualties of the rise of free information sources and a mass migration of advertisers from paid to free content. Newspaper industry revenue actually rose to record heights in the first decade of the web, reaching an all-time peak of nearly \$50 billion in 2005, only to drop to \$22.3 billion by the end of 2012. The great journalist Edwin Diamond, presciently paraphrased Tom Lehrer's “Wernher von Braun” at an Annenberg Washington Program conference on the Internet in 1995: “‘I make them go up, where they come down / Is not my department,’ said Wernher von Braun.”

Social media and other forms of promotion have siphoned off advertising budgets that until relatively recently were still a bonanza for established newspapers and magazines. Consider the *New York Times* Circuits section, which once appeared regularly and which featured pages of advertising for the latest laptops, cell phones, and other devices. One New York retailer alone, J&R Music World, once bought a page or more in every issue and was often on the back page of the weekly Science section as well. Earlier this year their retail store in lower Manhattan, which bounced back after the September 11 attacks, succumbed to online retailing. Their web business continues but is no longer a major *Times* advertising buyer. In the elite newspaper and magazine business, technology gave—and then it took away.

Book publishing, protected from media buyers' herd mentality, has been more stable. The problem is that the abundance of titles—300,000 from conventional publishers in the United States alone—has exceeded the market's ability to absorb them, leading to lower runs and higher prices. Amazon.com's dominance of online book retailing has helped provoke a series of disputes and lawsuits with publishers, and has ac-

celerated mergers that have absorbed many of the remaining high-quality mid-sized independent imprints. Of course, that concentration reduces authors' choices and limits competition of publishers for their work.

Books along with social media are thus becoming part of what might be called a loss leader society, extending from ever-expanding but still marginally profitable Amazon itself to the humblest tweeter. Unpaid or low-paid promotional activities aim at some long-term goal, whether ten-figure market dominance, speaking appearances, or merely a better job. Websites like BuzzFeed and the Huffington Post welcome this labor force, but even many of the oldest and most prestigious publications encourage their editors and contributors to generate blog posts and other features to help boost their social media visibility. The journalist Dean Starkman, reminded of cute pet rodents running in their exercise wheels, has dubbed the trend hamsterization.

A M I THEN, a fool in welcoming information abundance rather than joining the throng of cultural pessimists? There's actually a lot to be said for ignoring the odds sometimes; if you don't believe this, see Shelley Taylor's *Positive Illusions: Creative Self-Deception and the Healthy Mind* (Basic Books, 1989). As a recent *New York Times* exhibition review pointed out, if Christopher Columbus had not relied on Ptolemy's inaccurate estimate of the earth's circumference, he probably would never have tried to find a western route to China.

Alarming as some trends in higher education and the media have been since 1972, I'm lucky that I was displaced early and often. Necessity forced me to become the generalist that I was all along, even as I tried to deny it and stake out a specialty. I've even been able to write something more interesting in my original field—a study of the biology and culture of the German Shepherd Dog, still unpublished—than I would have if I had become a professor instead of a science editor. That experience helped inspire me to write a book I'm now completing on positive unintended consequences.

I'm also studying how schools and colleges can improve education for an information-abundant environment, in which people pull what they need from search engines and paid streaming services—including music, films, and television programs—rather than having them pushed as major broadcast networks once did. The Book-of-the-Month Club at its height even required members to opt out of each book; otherwise it was sent automatically.

(To get an idea of push and pull in the web context, compare the start page of Yahoo, with dozens of tantalizing links to news stories, weather, gossip, and videos, to the minimalist Google counterpart with little more than a search box.)

The new environment seems miraculous to people who recall the early days of electronic information. In the late 1980s and even the early 1990s, many databases still charged heavily for electronic articles, and it took a specially trained librarian to search these premium services efficiently. Today many colleges subscribe to Lexis-Nexis Academic, but I remember (as a contributor to *Money* and *Discover* Magazines) how a Lexis-Nexis search had to be conducted by a Time-Life librarian under a la carte pricing on a special terminal that used paper in rolls. Librarians are still essential experts in database searches, but they're not so much intermediaries as troubleshooters who can help formulate searches, identify the best databases, and intervene when results are disappointing.

Google's efficiency has created problems of its own. Libraries and bookstores have relatively few guides to Google use because the company's servers seem to read searchers' minds. For instance, a Princeton area resident entering "Northeast Corridor" will probably see an electronic copy of the printed New Jersey Transit schedule as the first or second result – as opposed, for example, to the many studies of the Boston-Washington area by geographers, planners, and economists. Based on past links, users' locations, and their previous searches, Google's servers can predict what they're probably looking for.

When issues are more complex than finding the best train to take, Google is not so miraculous. Its first page of results may be satisfactory and certainly better than those of earlier alternatives, but it often doesn't

give the highest rank to what most human experts would consider the most authoritative story. That's because bad information can generate many links, including some from people who are trying to refute it. That isn't a serious problem for users already familiar with a topic. Even a mediocre Wikipedia article—and they range from superb to misleading—may link to valuable additional resources. But what happens when a user is exploring a new topic? Most searchers never look beyond the first screen. To judge a source we need to have the knowledge we are trying to get from it! It's a bit like choosing a graduate program; to understand what trends and professors in a discipline offer the most promising future, an applicant almost needs the Ph.D. he or she is seeking.

THIS puzzle was known to Greek philosophers. A similar question was raised by Meno in Plato's dialogue of that name. Whatever the philosophical resolution of Meno's Paradox, there are tools for users of Google and other search engines to improve their results. Some of them are simply setting limits to sources by the type of site (e.g. preferring educational, government, and nonprofit sources) and date. Beyond that, searchers can get better results through a multistep process. They can first find the exact terms that experts use to discuss a product or social phenomenon; this helps eliminate the less informed results. Then they can often find the names of some of the most respected writers on a topic. When I write about technology and disasters, I look for work that cites people like Charles Perrow (who invented the phrase "normal accidents"), Diane Vaughan (who coined "normalization of deviance"), and Scott Snook (who identified "practical drift"—deviation from official procedures when relaxing them often falsely appears safe), and a number of social scientists who have identified "high reliability organizations." Names and concepts like these will help locate both scholarly articles and, especially for high school and college students, essays in general-interest magazines and journals.

The technique might be called knowledge bootstrapping. Another metaphor might be ratcheting. We can lift heavy loads with a ratcheting winch. With each pull of the lever it's raised a bit, and a pawl prevents the load from falling back. While other animals make and use tools, often with great skill and intelligence, so far no species has displayed the human capacity for experiment and continuous improvement. The good news for web users, and especially for students, is that with practice everybody learns techniques for refining their results and progressing to more sophisticated searches.

Finally, despite information abundance, some of the most essential knowledge remains in printed material that may never be digitized. Using printed works can be a way to get a competitive advantage against others relying only on digital sources. And browsing in print remains one of the best ways to discover ideas for further exploration on line.

Take Father Florovsky, for example. The online archives of the *Daily Princetonian* say nothing about his passion for photocopying. I learned about it only by chance. I had an hour or two on Mercer Street before lunch and dropped into the Princeton Theological Seminary library. I noticed the Gavriilyuk biography on the new-book shelf and picked it up at once because my undergraduate thesis advisor, James Billington—now Librarian of Congress—knew Florovsky well. Gavriilyuk's publisher has made that page, as it happens, available on the web through Google Book Search, so anybody can read about that phase of Florovsky's life. Yet no search for pioneering scholar-photocopiers on Google would have turned up Florovsky's name.

Serendipity has limits. As major research libraries have grown, more books are in remote storage, in giant depositories with semi-robotic retrieval. The Class of 1965 was part of the last generation that could encounter nearly all books in the open stacks.

Serendipity and accidental discovery are as powerful as ever in the age of Search. I'd hate to go back to the old days, but I'm glad that learning to search when it was too hard has prepared me to use the Web now that it has become so easy.

In fact we are part of a lucky cohort. In the brief time between the Silent Generation and the Baby

Boom, we were old enough to learn the traditional paper-based skills in our teens, but young enough to enter the new electronic world by our early thirties. Futurists may disagree on what's to come, but I believe we were in the right place at the right time.