IS A PICTURE REALLY WORTH A 1,000 WORDS?

COMPUTERS, VISUALIZATION, AND HISTORY: HOW NEW TECHNOLOGY WILL TRANSFORM OUR UNDERSTANDING OF THE PAST. By David J. Staley. Armonk, New York: M. E. Sharpe, 2002. Pp. xiii, 174.

David Staley's concise and clearly written book is dedicated to the thesis that history will be revolutionized by new visual display technologies, not only in its specific content (which constantly changes anyway) but in its very manner of thinking about and representing historical realities. In this, he is making a claim for a technological revolution in historical thought that promises to be as fundamental as the impact of similar technology on science. In my view, it is implicit to his argument that history should become more like the sciences.

This is not a small claim. He is not speaking here of using technology to discover and verify new ideas about the human past, that is, to provide the official storytellers of society with better evidence on which to base their official stories. Rather, he is hoping for the kind of revolutionary conceptual growth that was experienced by many scientific fields when they moved to a different methodology, and opened up new classes of theory and new domains of inquiry.

There is no doubt that technology can change our ways of thinking about the universe. Most of what we call modern civilization could not have been conceived of, let alone built, without appropriate technology. Technology is usually identified with an artifact, such as a stone tool or steel sword, that performs or supplements physical work. However, the term "technology" encompasses not only machines and physical tools, but also what Richard Gregory once called "mind-tools." Some kinds of technology perform cognitive work by supplementing memory or aiding the thought process itself. This includes the so-called symbolic technologies, such as notations and scripts, and also computational devices, such as sextants, observatories, and calculating machines, among many other things. Such technologies can radically change how a society remembers and represents reality. New classes of ideas are sometimes made possible by such technologies.

In fact, much of what we call "higher" intelligence is a product of marrying the raw intellectual power of the human brain to an appropriate technology. Literacy-related skills are the most obvious examples of this. Writing and related symbolic technologies, such as mathematical notations or musical scripts, enable the human mind to externalize its memory record in symbolic devices that exist outside the nervous system, making that record much more accessible and durable than the fleeting, evanescent, and hard-to-access memories afforded by the brain. External symbols can also change the way the brains of the members

of a society work, and in doing this they become integral to that society's larger "cognitive system." In technical terms, a reader's cognitive system temporarily includes both the external written display and the cognitive systems of the brain. This creates a "distributed" system that has properties that are quite different from those of the brain. Written records thus alter the way mental work is carried out, redistributing it between its traditional biological foundation in the brain and various external devices that amplify the power of the system. When many people are joined to a large distributed network mediated by written symbols, the result is an even more powerful group cognitive system that is able to perform certain kinds of mental work better than any individual. Large corporate enterprises are an example of this. Most human cultures encompass many corporate cognitive systems, arranged in institutional hierarchies that store, maintain, and transfer the accumulated knowledge of that culture.

In human prehistory, before writing was discovered, human cultural memory was mediated by oral and gestural means, including myth, religion, group custom, and ritual. The knowledge of a Stone Age tribe was maintained largely in individual memory and transferred to the next generation by apprenticeship and ritual, necessarily limiting the forms of mental representation to those that were easiest to remember and rehearse individually. Without books, archives, legal codices, or any other kind of external symbolic storage, such devices as repetition, rhyme, and rigid rote memorization were necessary to maintain an accurate group memory system. But the so-called "oral" tradition is very limited in capacity and vulnerable to error and extinction. Moreover, it makes certain kinds of thinking very difficult and in some cases impossible. Writing and other kinds of external devices, such as scientific instruments, drastically alter the kinds of representations that can be constructed and remembered. For this reason, the historical shift from "biological memory" to "external symbolic storage," which occurred relatively recently, was perhaps the most revolutionary single event in the history of the human species. It allowed a core component of the human cognitive system, its storage and retrieval system, to escape some of the limitations of biological memory. At the same time, as society gradually learned how to exploit this new system, with its virtually unlimited storage capacity, wider accessibility, and durability, humankind discovered new forms of representation.

Literacy allows human beings to achieve a conceptual distance from their ideas, arguments, and stories. In fact, ideas are taken out of their original situations in time and space and given a kind of ethereal immortality. This remarkable feat is taken for granted, but is, quite literally, impossible to achieve in preliterate oral cultures. Literacy also allows extensive refinement of the products of thinking—plans, proposals, inventions, designs, and so on—through repeated visitations and revisions. This can be done collectively and cumulatively, and allows us to overcome the limits of time and space that normally apply to biological memory. Writing freezes, reduces, and compresses knowledge, enabling the writer and reader to polish ideas and arguments as if they were crafted objects. Oral cultures tend to find it difficult to examine and refine their basic ideas and assumptions, and as a result, they tend to be rather rigid and inflexible,

and change slowly from within. Their members are given very few intellectual choices, not because of limited intellectual capacity, but because of the absence of external symbolic technology.

The impact of innovations in symbolic technology on human intellectual creativity should not be underestimated. Mathematics is the clearest example of this. The history of mathematical thought amounts to a history of building increasingly powerful systems of notation. Certain mathematical ideas simply cannot be conceived of without notational breakthroughs. Roman mathematicians were hobbled by their primitive ways of representing numbers, and even elementary operations, such as division and multiplication, were extremely difficult to carry out. Arabic notation broke through some of these limitations and opened up new classes of mathematical insights that were formerly impossible. Other seemingly simple conceptual tools, such as the decimal point and equal sign, brought their own revolutions. Some conceptually radical innovations, such as Boolean algebra, permanently widened the set of possible ideas that mathematicians could contemplate. In the latter case, a path was opened to the digital computer, and this, in turn, changed the nature of the game altogether. This process of interplay—among the brain, notational tools, and "hard" technologies—was a cumulative process, and it has exploded during the past two centuries.

The same is true of our technologies of visual representation. Basic technologies, such as durable pigments and simple oil lamps, had to precede the creation of elaborate cave paintings, such as those of Peche-Merle or Lascaux. Lenses, and then telescopes and microscopes, opened up entirely new cognitive domains that were previously out of reach. More complex visual thinking tools, such as astronomical observatories, compasses, sextants, theodolites, calendars, and other specialized instruments of measurement, allowed the observer to see the world anew, and led to various marriages of abstract theory, mind-tools, and hard technology. Telescopes and microscopes did more than extend the range of human vision to the domains of the very large and very small; they also opened up new intellectual domains. Sextants and theodolites expanded our range in a different way: they made it possible for human beings to extend very abstract notions into the physical ether, and to apply them to practical endeavors, such as navigation and engineering.

Again, and to risk redundancy, the same applies to music and most of the arts. Musical technology has become a very powerful means of condensing and controlling auditory experience, comparing and contrasting musical viewpoints, and transcending the normal limits of time and space that apply to the production of natural sound. The invention of polyphony is a perfect example of combining one technology, writing, with another, the making of instruments. Polyphony revolutionized music, hugely multiplying the possibilities of that domain. Composers were freed to experiment and to extend the range of acoustic possibility. A new auditory phenomenon known as "melody" became possible. Counterpoint also came into existence *de novo*. As the technology of notation and instrumentation became more sophisticated, the possible structures of compositions became immensely more complex. The distance traveled, from elementary ritual and

dance, to acoustic mimesis in theatrical settings, to the invention of complex musical instruments, and then to such orchestrated and technologically-sophisticated media as orchestral music, opera, and film, is another example of a cumulative historical process, essentially cognitive in nature, that was dependent on technology.

The computer has radically accelerated this series of changes. It has given our civilization a unique opportunity to advance and integrate many of these historical trends in the development of art. At the same time, science, navigation, and industry have been changed in unprecedented ways by the same process. The management of the corporate world has been transformed by computers. Major multinational corporations, such as IBM, General Motors, and Mercedes Benz, as well as government organizations such as NASA, are currently experimenting with new ways of merging humans and computers into larger cybernetic systems wedded to technology, creating hybrid webs, the so-called "distributed" computational systems that combine the power of many human brains with the power of a larger communication and memory system that encompasses many technologies. Such systems are predicted eventually to become capable of more effective creative thought than is possible for individual humans. This prediction has not been proven, but given the changes we have witnessed over the last century, it would be foolish to dismiss it out of hand.

The question is, where does the discipline of history stand in all this? Viewed intuitively, history seems to exist outside of this technological process, at least on a conceptual level. History is technology-bound to a degree, especially on the level of assembling evidence. Historical research is difficult without extensive recordkeeping in government archives, libraries, and databases. Increasingly, it also depends on electronic search engines and technologies that compress information. But, unlike mathematics or music, at first glance history might seem invulnerable to a technology-driven conceptual revolution. History constructs (and deconstructs, which amounts to a reversed and recursive application of the same mental process) stories about the past. It does this with the help of technology, but it still seems comfortably old-fashioned in its conceptual approach. To most of us on the outside, history is like an old sofa or a well-worn cardigan. We expect it to be a natural extension of oral storytelling. Few people want history to become a discipline that is as alien to common sense, or as conceptually out of reach as, say, particle physics, or organic chemistry, or even economics. Human beings, after all, are storytellers to the core. This is the truly special gift of humanity, and stories constitute the heart and soul of human cultures. Stories define cultural identity, set out role models for children, instruct society about moral (and immoral) behavior, and set the parameters of basic customs and social practice. Stories run our collective polis. And historians are the principal writers, editors, and keepers of those stories. This gives them a special status, somewhat akin to the high priests of yesteryear. How could it be otherwise?

THE TROUBLE WITH "LINELAND"

Yet David Staley feels otherwise. He sees the possibility of a conceptual revolution in historical thought based on new technology. In this, he wants history to

emulate science, which took several hundred years to shift from the metaphors, analogies, and stories of alchemy, to the pragmatism, skepticism, and logical rigor of modern science.

Staley parodies the traditional storytelling forms of historical thought as a conceptual prison called "Lineland." Lineland is dominated by the tendency to seek out and create linear scenarios (that is, stories) where B follows from A, and C follows from B. Students are given handbooks of proper writing style, and generally subscribe to the Hegelian notion that the "text" is effectively the basis of civilized life. He cites Illich and Sanders on the central importance of the written word in shaping history. But words impose an arbitrary linear structure on history. In his own words: "Historians chose to write because of tradition, convention, and faith; however, we should also recognize that there is nothing natural or axiomatic about writing about the past; it is only a preference" (19).

The trouble with Lineland, says Staley, is that its methodology, the construction of written accounts, is inherently flawed. It ignores other methods of assessing evidence that do not impose this arbitrary linear structure, but rather encourage a process that some psychologists call "simultaneous synthesis," which is also known as impression-formation or analogue thought. This kind of thinking is predominant in art and in some scientific fields, where words and prose accounts are reduced to the role of hitching a ride on the insights gathered from analogue thinking.

It is hard to dispute the idea that there are many historical insights that might be gained from these kinds of methods, especially the visually-based, multidimensional forms of thought that dominate science and mathematics. Historical evidence is based on multitudes of individual events and episodes in many different places, some simultaneous and parallel, others arranged in a linear causal chain. This database in itself is no more linear than, say, the raw material for the theory of evolution, or accounts of the Big Bang, and theories in these domains do not rely on prose accounts. The prose accounts are for the diffusion of insights gleaned from other methods. Scientists use visual methods of forming impressions, and create novel theoretical syntheses from these on a daily basis. The question of entering these new scientific ideas into the most current version of our social "text" comes only later, almost as an afterthought. In many esoteric areas of science, it never comes at all.

Indeed, science is almost never based on stories. Science has been built mostly from "stamp collecting," that is, gathering impressions, analyzing these impressions, and often, organizing them visually or mathematically into models that are largely visual in their genesis. Many fundamental scientific breakthroughs, from plate tectonics to topology and anatomy, and from the double helix to the table of elements, are predominantly a result of visualization and multidimensional synthesis. Big Bang theory, atomic structure, and neural networks are all highly visual in their origins. Thus the technology of visual representation is crucial for science. This can be seen in the format of scientific papers, where evidence is plotted in histograms and various complex visual representations. A paper in *Science* or *Nature* has a strict limit of about 2000 words,

but may be crammed with every sort of visual illustration imaginable. There is no room here for what historians call "style." Words are arranged in extremely precise sentences and paragraphs, and ruthlessly pared away until nothing is left but the absolute minimum needed to convey meaning. Multidimensional arrays are simplified mathematically by the use of various techniques that might resolve, for instance, a fantastically complex n-dimensional data cloud into a simpler solution that is more easily digested by the human mind.

Staley sees the future of history here. He proposes that a revolutionary shift towards similar conceptual tools to those of science will eventually redefine the discipline. He makes this prediction on the basis of both the past experience of science and a careful examination of the present theoretical dilemmas facing historians. He argues that the media of visual representation can transform the way historians observe, represent, and think about history.

As a non-historian, I will refrain from evaluating those conceptual issues raised by Staley that strike me as strictly historical, and focus more on the underlying logic of his book. His core argument is based on a set of cognitive assumptions. It proceeds as follows. Traditional historians believe that visualization (as in maps, charts, tables, and so on) is a subordinate methodology to the prose account that brings these sources together into a story. They believe, with Hegel, that language is the ruling faculty of the mind, especially written language. All else is subservient to language, and thus to strings of words assembled in sentences. The ubiquity of this implicit belief is evident in the fact that historians are obliged by their colleagues to publish prose papers and books, as opposed to, say, historical maps, flow charts, tables of elements, simulations, or 3-D re-enactments. Students are trained to write, and are expected to "cut their teeth" as historians by producing large numbers of prose accounts in the form of term papers and theses. These must follow a conventional form. It may be true that deconstructionism dealt a blow to the believability of traditional prose accounts, but its own methodology was, and remains, entirely prose-based. Historians still write, albeit more skeptically. The prose account remains in its traditional position of dominance.

Staley argues that this situation is stifling historical thought. He believes that there are many forms of visualization that can contribute to historical thought, and should become more widely used in the curriculum, in graduate theses, and in professional journals. Indeed, he argues that these visualization techniques should be granted higher status among historians, simply because they promise to "work" better than prose in describing and accounting for the events of the past, and especially in constructing better theories of history. These forms include sophisticated kinds of historical cartography, flowcharts, "cause boxes," multidimensional clustering techniques, and network simulations. If these methods seem familiar, it is because they are already in wide use in the natural and social sciences.

In his last three chapters, Staley summarizes the visual methodologies he finds most promising for use by historians. These include galleries of images, museums, film and television, dramatic recreations, maps and atlases, and pictorial

illustrations of data that illustrate the "systemic flow" underlying the organization of a given society, somewhat the way management flowcharts achieve the same thing for corporations.

While it is true that, in the past, the methods of historical verification have depended on the occasional use of such methods, the conceptual basis of history seems to have simpler and deeper roots, and its fundamental methodology for thinking about arrays of data, synthesizing evidence, and building mental models of that evidence has not profited as much from these methods, at least at first glance, as have many other disciplines. Despite the availability of so many new methods of representing data visually, history is, in its conception, still more like autobiography than it is like, say, musicology, film theory, or philosophy. In fact, precisely because it is so "old-fashioned" in its reliance on prose accounts, history enables us to look at such things as modern music and film with a colder, more dispassionate eye. To many of us, this is just fine. Stories are a necessary, and in the case of human society, mostly valid methodology. Many of us do not want to conceive of history as anything else.

As a reviewer, I suppose I should feel obliged to form a judgment of Staley's rather utopian belief in visual methods of data analysis. I think he is far too dismissive of the power of prose accounts, and the central importance of the most basic forms of human communication, which define social life and imbue it with meaning. We cannot do without these. Even Cal Tech dons who spend their lives chasing bosons and quarks share that basic need and use these basic forms. We are hard-wired to scaffold all our more abstract notions of the universe on this foundation. These basic forms cover even such things as the built environment and its symbolism, as well as custom, tribal identity, ritual, myth, and belief. There is no way to avoid or circumvent these things, and who would want to? They are the glory of human life. The text happens to be the most popular and widely circulated means for building a formal, publicly edited encapsulation of these basic elements of our worldviews. And we cannot do without it.

But we should be careful not to turn the tables, and dismiss Staley too glibly. There is much value in what he is saying. Computers and high-tech methods of visualization are now found everywhere, and have become a part of daily life for billions of people through television and the internet. They are changing the way we perceive not only history, but daily reality itself. Historians cannot ignore this development any more than anyone else can. Indeed, they already use these ways of seeing, whether they realize it or not. It is perhaps more a question of explicitly acknowledging this fact and changing the training of historians so that they are equipped to capitalize on the opportunities these methods have opened up. If Staley's book helps that process along, it will have been well worth the trouble of writing it, which he has done quite well, supplementing his story beautifully by helpful visual illustrations.

MERLIN DONALD

Queen's University,
Kingston, Ontario, Canada