Eight Bits About Digital Communication

By Lance Strate

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I would like to express my gratitude to Octavio Islas, the "eighth man," for inviting me to particpate in the *V Bienal Iberoamericana de la Comunicación* .

I imagine that many of you are familiar with the fact that five years after Christopher Columbus set foot in the New World, King Ferdinand and Queen Isabella reformed the Spanish monetary system, standardizing the minting of royal coins or *Reales* . They also created new coins in the denominations of half Reales, quarter Reales, and eighth Reales. But so much silver was found in Mexico and elsewhere in the western hemisphere, that it soon became possible to create coins of larger denominations, first two reales, then four, and finally eight reales.

The *ocho reales* coin became known as the *peso* , which as you know means weight. From antiquity, the value of coins was based on their weight in precious metals, and this had much to do with what the coins were named. For example, in ancient Israel the shekel was a measurement unit for weight before it became a monetary unit. The *talanton* was an ancient Greek coin whose name originally referred to a weight used in a scale; this is the origin of the word *talent* , something of value to be weighed in the balance (a fact that sheds new light on the popular TV program, *American Idol*). And in Rome there was a coin known as the *libra* , the Roman word for pound; nowadays, we think of Libra as a zodiac sign, Libra the Scales. The ancient libra coin is the ancestor of the Italian lira, and also the British pound, which is why they use a modified letter "L" (i.e., £) as their symbol. Interestingly enough, the English word *pound* comes from the Latin word for weight, *pondo* , originally *libra pondo* which means a pound by weight, and *pondo* is also the ancestor of the Spanish word *peso* .

For centuries, the *ocho reales* was the most widely circulated form of currency in the world, enjoying a position analogous to the American dollar today. In fact, following the American Revolution, the founding fathers refused to continue using English pounds, and adopted the Spanish peso as their basic monetary unit. They gave it the name "dollar," which is of Germanic origin, and substituted a metric system of one hundred cents to the dollar rather than eight reales. But the Spanish dollar, as the peso came to be called, continued to be accepted as legal tender in the United States up until 1857, and in Canada until 1860. The quality of the silver was so pure that the Spanish dollar

was also known as an "honest dollar," a term that remained in circulation in the U.S. long after the peso was demonetized.

Because the value of the coin was based on its weight, it was a common practice to make change by cutting the ocho reales in half, quarters, or eighths. Based on this practice, the phrase *pieces of eight* came into circulation, and was picked up in pirate stories such as Robert Louis Stevenson's *Treasure Island* . No doubt, real pirates treasured their pieces of eight, and their dubloons, gold coins that were double the worth of the silver dollar. And even though the United States had no coins that were the equivalent of one eighth of a dollar, American children recited the nursery rhyme: "two bits, four bits, six bits, a dollar." Two bits, in particular, became slang for the quarter, our twenty-five cent piece, and a number of songs repeated the line, "shave and a haircut, two bits." Following the stock market crash in 1929, "two bit" became an adjective indicating that an item is cheap, second-rate, inferior. And while the pirates of the Caribbean treasured pieces of eight, the pirates of the American stock exchange priced their equities in denominations of one eighth of a dollar up until 1997, when they switched to sixteenths; a decimal system was finally adopted in 2001. It is altogether extraordinary that American stocks were priced in units that do not exist in the U.S. monetary system into the twenty-first century.

But is it any less extraordinary to discover that there are pirates among us once again, and that the pieces of eight that they treasure are not bits of silver and gold, but bits of data and information? Putting software pirates aside for the moment, I think we can assume that Claude Shannon knew something about the monetary meaning of the word *bit* when he introduced its new meaning in 1948, as a contraction of the phrase *binary digit* and the basic unit of information.

Eight years later, Werner Buchholz coined the term *byte* , spelling it with a *y* instead of an *i* to avoid the potential for mistakes and confusion. The byte consists of eight bits-it is the digital equivalent of the ocho reales. And multiples of eight are the rule in the digital realm. For example, technically, a kilobyte is not 1,000 bytes, but rather 1,024 bytes, while a megabyte is 1,048,576 bytes, and a gigabyte is 1,073,741,824 bytes. My first computer was an Atari 800, and it came with 16K of memory; I eventually increased it to the maximum, which was 48K. And programmers writing software for those first personal computers frequently worked in base sixteen systems known as hexadecimal.

You may find it interesting to know that hexadecimal is an unusual term, in that *hexa* comes from the Greek for *six* while *decimal* is derived from the Latin for *ten* . It was Buchholz's employers, IBM, who adopted this term because they were too embarrassed to use the purely Latin term, sexidecimal. We can only be grateful that no one at IBM brought up the fact that the numeral eight looks a lot like the female form.

I bring all this up because the number eight has a great deal of significance for us, in the context of Iberoamerica and Angloamerica. And it has a great deal of significance for us in the context of the theme of the *V Bienal Iberoamericana de la Comunicación* , which involves applying the balance or scales, and weighing and evaluating our new era of digital communication. And so, my plan is to provide you with eight bits of information,

which I hope will constitute one bite of knowledge, and perhaps even a small taste of wisdom.

1. Crazy Eights

Crazy eights is the name of a card game in which the eight of spades, hearts, diamonds, and clubs all are wild cards, and this is also a good name for my first bit which is about the role of the number eight in digital communication. And you can call them crazy, because at first glance counting by eights seems irrational, as opposed to counting by tens, which seems both rational and natural.

In *Understanding Media* , Marshall McLuhan (2003) explored the idea that media are extensions of the human body, and he argued that numbers are an extension of the sense of touch. We certainly can see that base ten mathematics are an extension of our fingers and toes, and that this makes counting by tens seem only natural. In fact, we can count with our fingers (give me five!), count on our fingers, and also count by pointing at objects in our environment. In all of these ways, we can see why the original meaning of the word digit is finger, and why it later came to mean number as well.

Digital does not mean decimal, however, and it was the rise of modern science and the Enlightenment that led to the creation and adoption of base ten systems, such as the American monetary system of one hundred cents to the dollar, and the use of floating point numbers, otherwise known as scientific notation. And following the French Revolution, the metric system was introduced to increase the efficiency and ease of measurements and calculations. Today, the United States is considered irrational in its reluctance to adopt the metric system, although I expect that digital technologies will soon speed the transition, or render it irrelevant.

Given the dominance of decimal systems, it seems crazy to count by eights. But in reality it is far from irrational. For example, growing up in New York City, I spent a good deal of time in pizza places, and always ordered pizza by the slice. And inevitably, there were eight slices to the pie. Over and over again, I watched them take the pie out of the oven, and cut them into eight slices. Why eight? Simply put, it is the most rational and efficient way to divide a pizza. One cut and you have two halves, another and you have four quarters; repeat the operation twice more and you have your slices of eight. The same logic extends to coins such as the peso: cut it in half, cut the half in half to make a quarter, and one more cut gives you two bits. Pieces of eight and slices of pizza both reflect the logic of cutting.

The same is true of the binary logic of digital communication. Each bit of information cuts possibilities in half. If there are two possibilities, such as determining whether a number is even or odd, it takes one bit of information to eliminate the uncertainty. If there are four possibilities, such as determining the suit of a playing card, it would take two bits of information, one to determine whether the card is red or black, the other to determine which of the two possible suits it is. If we have thirty-two possibilities, such as the states of Mexico along with the federal district of Mexico City, it would take five bits

of information to cut the choices down to a certainty, each time reducing possibilities by half.

It also takes as many as five bits when dealing with the twenty-six letters of the alphabet (you would have to get down to sixteen possibilities to require only four bits). Include both upper and lower case characters and we have fifty-two letters, which require six bits of information. Add the numerals zero through nine, and punctuation marks, and we have something on the order of eighty characters. At this point we need seven bits of information, with room to add additional characters up to 128. And 128 is the magic number of the American Standard Code for Information Interchange, otherwise known as ASCII. This is the basic alphanumeric code of digital communications, and it is for this reason that the byte became the standard unit of measurement. The eighth bit was originally used for error checking, representing for example how many ones as opposed to zeroes appear in the rest of the byte.

In sum, eights are not so crazy, at least not in coins and computers. This process of finding the rationale for human arrangements is sometimes known as cultural history. But I want to stress the intersection between cultural history and media ecology, which is the study of media environments. And this brings me to my second bit.

2. The Medium is the Message

I think of McLuhan's famous phrase, "the medium is the message" (2003, p. 17) as the first axiom of media ecology, although it may be more accurate to refer to it as the first aphorism of media ecology. It is an extraordinarily rich statement, and I have elsewhere explored many of its meanings (see, for example, Strate, 2005), but time does not permit me to do so here. Instead, I will simply suggest that McLuhan directs our attention to the medium as a starting point for our investigations, and he and other media ecologists use the term *medium* in its broadest sense to mean the forms and materials that we utilize, and the means and methods that we employ.

For example, in the case of a pizza pie, given its form, its size and shape, and the use of a pizza cutter, it makes perfect sense that it is cut four times to yield eight slices. Of course it would be possible to divide the pie into six slices, which sometimes happens, or ten slices for that matter. But the bias of the medium brings us back to eight time and time again. And the same is true when we cut silver coins into bits and pieces of eight. By the same token, behind the binary logic of digital communication there are technologies associated with electrical current and electromagnetic radiation.

Electrical current has the two basic states of on or off, and electromagnetic charge has the two basic states of positive and negative. Of course, electricity can be used analogically to reproduce sounds and images, but the bias favors the digital. Whenever digital technologies are developed, for example in sound recordings, in mobile telephones, and now in video, they replace their analogical equivalents. Interestingly enough, the first form of electric communication, the telegraph, transmitted messages analogically using an essentially binary code of dots and dashes (the silence between

the long and short beeps constituted a third type of signal, however), and here too contemporary digital technologies have rendered Morse code obsolete.

The binary logic of electric technology can be used to represent any number of polar oppositions, such as yes and no, true and false, up and down, black and white, and of course the numbers zero and one. But the point is that the true machine language of the computer is not the base two number system, but the song of the subatomic particle. Bits are electromagnetic units, and digital communication follows the bias of the electronic media. That is why McLuhan's analysis of the electric age is so appropriate for our current digital era (as my colleague, Paul Levinson, 1999, has so thoroughly demonstrated).

3. The Digital Ages

We may be in a new era of digital communication, but we are certainly not new to digital communication. That is why I have devoted my third bit to what I call *the digital ages* . Nevertheless, I should acknowledge that if we begin with the idea that the physical universe is an information system, we might conclude that there is only one digital age- the age of the universe itself. And if we begin with the idea that DNA is genetic *code* , in base four rather than binary of course, we might conclude that the digital age begins with the origin of life. Moreover, if we begin with the idea that digital communication is present in the nervous system, where individual synapses either fire or do not fire, then we might conclude that the digital age begins long before primates walked the earth.

Instead, I want to take a human-centered approach, and begin with the origin of our species. While there is much we do not know, and may never know about hominid evolution, it is certainly clear that it is speech, language, more generally the capacity for symbolic communication, that distinguishes *homo sapiens* . We do not know when speech began, because sounds leave no traces or fossils, but I think it reasonable to argue that symbolic communication is what makes us human. And language is our first form of digital communication, a point made by Paul Watzlawick, Janet Beavin Bavelas, and Don Jackson in *Pragmatics of Human Communication* , a book that helped to shape the modern field of communication studies when it was published back in 1967. Symbols are digital because they are discrete units that function as arbitrary representations. Language allows us to digitize the world, to break it down into manageable units of information that our minds can process, and ultimately manipulate. And as Watzlawick and his colleagues note, human beings are the only organisms who use digital modes of communication, at least in the exteriorized sense.

I know that some people will take exception to what I am saying, and argue that when we speak of digital communication, we are talking about technology, and language is not a technology. This distinction is generally based on the fact that language is viewed as natural, the product of a genetic predisposition in our species, whereas technology is seen as artificial. I find this distinction absurd, because we would not have technology if we did not have a genetic predisposition to create it. Evolution has given us a set of fingers that include opposable thumbs, with which we have made tools and technologies, and it has given us mouths that include opposable tongues, with which we

have made dialogue and knowledge. Both our fingers and our mouths, each in their own way, lead to digital communication. And rather than viewing either language or technology as artificial, I believe we should think of technology as natural, and not only to our own species. The anthropologist Edward T. Hall (1959, 1976) has made this point, as has Lewis Mumford (1952, 1961, 1967, 1970), who is sometimes regarded as the first media ecologist. Birds build nests, beavers make dams, bees build hives, and these constructions far exceed in complexity any technological activity that we human beings engaged in for the vast majority of our time on earth.

What distinguishes us is not our tools, but our talk. And so, our first digital age is based on speech. Our second digital age is based on forms of notation, and especially writing, which essentially coincides with the transition from tribal societies to what we think of as civilization. Numerical notation is needed to deal with increasingly more complex economies, and the development of calendars, weights, and measures is part of the process. The first complete writing system was developed by Sumerian accountants in ancient Mesopotamia circa 3500 B. C. E., according to Denise Schmandt-Besserat (1992, 1996). The first writing systems, known as logographic writing, used a single character to stand for an entire word, much like the numeral five (5) stands for the entire sound ("five," "cinco," "cinq," "fünf," etc.). This was sufficient to divide complete vocalizations into discrete visual symbols, as we do not necessarily pause in between words when we speak.

Moreover, in keeping accounts and making lists, writing separated subject from predicate in a way that would be highly unusual in everyday discourse. We do not go around saying "a cow, a rooster, seventeen chickens, twenty-three bushels of wheat," (if we did, the response would be, "what about them, what are you trying to say?"). As Jack Goody (1977) argues, writing decontextualizes language in numerous ways, taking words out of the concrete context that helps to establish their meaning. It follows that all forms of digitization involve a process of decontextualization, constantly requiring us to re-establish contexts and search for meaning.

The development of phonetic writing systems represented a further digitization of speech. First, words were represented by characters that stood for entire syllables (for example, one character for *ba* , another for *be* , and still others for *bi* , *bo* , *bu* , etc.). Then came the Semitic aleph-bet, which reduced the syllables down to a single consonant (for example the letter *bet* , ancestor our letter *b*). Neil Postman (1985) has argued that the Second Commandment of Moses, the prohibition against the making of graven images, was intended to eliminate the analogic mode of communication through pictures, in order to reinforce the digital mode of communication associated with literacy.

The ancient Greeks picked up the aleph-bet from Phoenician traders, adding vowels to make it more effective. In Greek myths, it is a Phoenician, King Cadmus, who invented the alphabet, and also sowed dragon's teeth to grow an army. I cannot help but point out that the ancient bite of the dragon leads us to the contemporary byte of the ASCII alphanumeric code. Or to give an example of the continuing significance of the second digital age to our own, it turns out that while the fax machine was adopted relatively rapidly in Japan, the diffusion of e-mail was somewhat slow, especially in comparison to

Korea. The explanation is simple enough. Korea uses an alphabet. Japan uses a syllabic writing system that consists of close to one hundred different characters (while also drawing on Chinese ideograms and our own Roman letters), making it more difficult to use a keyboard, and more desirable to write by hand and transmit a facsimile (Fouser, 2001).

During the second digital age, writing and especially the alphabet opened the door to many forms of digitization. In Asia Minor, in a kingdom heavily influenced by Greek culture, the Lydians minted the first coins, the ancestors of the ocho reales. This occurred in the seventh century B.C.E., not long after the introduction of the Greek alphabet, and constituted the first complete form of economic digitization. In the nearby Greek colony of Ionia, the first philosophers used coins and the alphabet as an analogy, arriving at the first theory that all matter is composed of discrete units, that is, atoms.

During the sixth century B.C.E., the Semitic aleph-bet reached India, where it was gradually adapted and adopted; in its wake came the Hindu invention of the number zero and positional notation, without which we would not have much in the way of mathematics (Logan, 2004). In terms of numeracy alone, this was the beginning of a new digital age. At some point around the thirteenth century C.E. in Europe, in one of the isolated islands of alphabetic literacy known as monasteries, time was digitized by the invention of the mechanical clock (Landes, 2000; Mumford, 1934). Lewis Mumford maintains that this was the beginning of the process of mechanization and industrialization, reason enough to consider it the beginning of a new digital age.

The alphabet was a necessary precondition for the invention of Gutenberg's printing press in the fifteenth century, a point that Walter Ong (1982) stresses. In and of itself, forms of printing go back to prehistory, and a significant development in the history of printing was the first minting of coins in ancient Lydia. What Gutenberg accomplished was the digitization of print along the lines of the alphabet, by breaking the single image or page down into metal bits, otherwise known as moveable type, which can be put together, broken apart, and rearranged in innumerable combinations. And by producing multiple, identical copies of texts, typography brought with it a new emphasis on standardization, in the making of books, in spelling, grammar and education, in legal systems based on written laws and codes, and in weights and measures, leading to the uniformity of the metric system.

As the historian Elizabeth Eisenstein (1979) has documented, the printing revolution in early modern Europe made possible the rise of modern science. And with it came experimentation with electricity, such as Benjamin Franklin conducted in the eighteenth century. In this sense, the Enlightenment brought with it a new digital age based on the dialectics of the positive and negative charges that Franklin discovered, the dots and dashes that Samuel Morse employed in his telegraph, and the dialectic of on and off that accompanied Thomas Edison's light bulb. And electrical technologies lead us in turn to such mid-twentieth century developments as Claude Shannon's information theory (Shannon & Weaver, 1949), Norbert Wiener's (1950, 1961) cybernetics, and the first electronic digital computers.

We can therefore consider eight overlapping and interrelated digital ages, the ages of speech, of writing, of the alphabet, of the zero and positional notation, of the clock and mechanization, of typography, of electricity, and finally the computer. This keeps us to the theme of the number eight. Of course, there is more than one way to cut our ocho reales, and media ecologists often focus on four ages, or types of culture, or media environments. The first is associated with speech and orality, the second with writing by hand, the third with printing, and the fourth with the electronic media. When you slice things up in this way, we can see that we have undergone a series of digitizations, as speech, the first form of digital communication, is digitized by writing, writing is digitized by print, and print in turn has been digitized by electronic technologies. You might say that human beings have a genetic predisposition towards digitizing, and through this process we transform our environments, and ourselves.

4. Cut, Copy, and Paste

I have made frequent reference to the cutting of the ocho reales into pieces of eight, and also to the function of the bit of information in cutting possibilities in half, and for my fourth bit I want to return to the logic of cutting, and the basic tools known as cut, copy, and paste. But first, let me note that for almost all of the past three million years, *high tech* took the form of tool kits consisting of sharpened pieces of stone (see, for example, Leaky & Lewin, 1978). These tool kits included three types of stone knives, one for skinning and otherwise preparing meat, another for working with vegetables and fruits, and a third used to create other tools out of wood and bone. The tool kits were ubiquitous in our prehistory to an extent that is truly extraordinary, as they are found across a vast range of climates and habitats, across isolated populations separated by great distances, and most remarkably, across different species of hominids. The stone tools themselves were subject to surprisingly little innovation or evolution over this long period of time that came to an end with a creative explosion that laid the foundations for modern technological societies approximately 30,000 years ago (Pfeiffer, 1982).

The distance from the stone chips of the hominids to the silicon chips of home computers seems unimaginable. And yet it is all but instantaneous in comparison to the millions of years during which the prehistoric tool kit served as the indispensable key to the survival and success of our evolutionary ancestors. Moreover, these two moments of stone and silicon are connected by a "missing link"-the technologies of writing and printing. The stone knife used to sharpen, carve and fashion other tools out of wood and bone also could make marks on their surfaces, both accidental and purposeful, both aesthetic and symbolic.

Just as our ancestors used stone tools to hunt, gather, and process their food, we use digital tools to hunt and gather alphanumeric data, and to process words, numbers, images, and sounds. Of course, we have a great many tools in our digital tool kits, but there is, I would argue, a contemporary equivalent to the three stone knives of prehistory: Cut, Copy, and Paste. I would go so far as to say that these three commands are archetypes of word processing and computer programming, and that they are possibly ideal, certainly exemplary forms of the human activity of tool-use. As such, the basic function of Cut, Copy, and Paste is the modification and manipulation of human

environments. These digital tools influence and alter our information environment, much as the prehistoric tool kit was used to act on the natural environment. Of the three, Cut is clearly a direct descendant of the stone knife, and would have to be the most basic activity as it can be performed with teeth (the first bit and bite of information). It follows that Cut appears first in the Edit menu of current operating systems.

Copying comes next, and the ubiquity of the stone knives themselves over millions of years is a testament to the primacy of the act of copying. No doubt cutting came first, through the use of found objects. But copying implies the deliberate manufacture of cutting tools, not just tool use but tool making. It represents a great leap forward in technological development as well as biological evolution, a milestone on the road to humanity. As for paste, it is a tool whose traces are wiped out over time, in contrast to the stone knives that speak to us across millions of years, and it is therefore difficult to discuss the origins of pasting with any certainty. However, it seems reasonable to conclude that our evolutionary ancestors noticed the adhesive properties of certain substances, and employed them in limited ways prior to the creative explosion. Paste therefore is appropriately listed last of the three in the Edit menu, and its development may well have been based on the processing of animal and vegetable products that stone knives made possible.

Whatever their origins, we can certainly conclude that cutting, copying, and pasting originate as prehistoric technical activities, as methods of manipulating the environment. Moreover, these three tools cover the most basic types of technological operations: Cutting implies taking a whole and breaking it into smaller parts. Pasting implies joining together separate parts to form a larger whole. And copying implies the repetition of either or both of the other two actions in order to achieve similar results. We can also see here the beginnings of arithmetic operations.

When the same operations are applied to language and writing, we are able to edit reality and edit our own digital communication. In other words, another basic function of Cut, Copy, and Paste is the modification and manipulation of symbolic environments. And this in turn implies the modification and manipulation of technological environments, and with it the notion of progress. In fact, editing brings with it new standards of perfection, and new ideals of perfectibility. This has been cause for concern, especially when applied to DNA.

Of course, the digital tool kit reflects the biases of binary code, in that what is really being manipulated are bits of information. And because we are dealing with bits of information and not material substances, manipulation is fairly easy to accomplish. Our contemporary digital world appears to be infinitely malleable, and this makes it difficult to recognize the limitations of biology, and physics. Or economics. When printing made the mass production of texts profitable, copyright legislation followed, and patents, trademarks, and other forms of intellectual property rights followed the precedent of copyright. As the electronic media displace typography, Cut, Copy, and Paste operations become all too easy to perform, and we see these rights increasingly disregarded, while many of us, especially in academia, confront the problem of plagiarism. This is the bias of the electronic media, and the online world also retrieves in

certain way the old gift economy in new form. Oddly enough, just as the old, industrial-based Communism was collapsing in Europe, the Internet was giving us a new kind of cybercommunism (Barbrook, 2002, in print).

5. Cybertime

The activity of cutting with tools comes early in human evolution, probably long before the evolution of speech. Language brings with it the ability to preserve information over time, and pass it on from generation to generation, what Alfred Korzybski (1993) called time-binding. It also brings an awareness of time, and the activity of time-keeping, especially through notational systems. And this brings me to my fifth bit, *cybertime* , a concept I have discussed at length elsewhere. Computers represent the convergence of a number of different technologies, and one of them is the mechanical clock, the first form of automatic machinery. Like the computer, the clock is a device that manufactures no physical products, but instead produces pure information. Moreover, as Lewis Mumford (1934) makes clear, the clock's main function is to coordinate and synchronize activities and events. It is an early technology of control, a forerunner of cybernetics and computing (Beniger, 1986; Bolter, 1984; Weizenbaum, 1976; Wiener, 1950, 1961).

The digital computer actually incorporates an electronic clock within its central processor, which controls the computer's functions. The clock's frequency (number of cycles per second, measured by the million in megahertz) determines the computer's processing speed, and it is not unusual for computers to incorporate additional clocks to perform other functions (Wyant & Hammerstron, 1994). Like dedicated timepieces, the computer clock can be used to measure duration, determine the present point in time, and even provide alerts along the lines of an alarm clock. The function of the clock is to tell the time of the outside world, but while traditional timepieces only measure time's passage, and are not seen as creating time out of whole cloth, the central processor does generate time for the computer's internal world. This electronic heartbeat *is* time insofar as the computer's microworld is concerned.

Cybertime is digital time, and this means something more than the digital display of time in clocks and watches that do not use the traditional clock face. But it is worth noting that digital timepieces, which were introduced to the consumer market in the late 1960s, have been criticized because they present a discrete and decontextualized sense of time. The traditional clock face provides a context that includes every possible time of day, out of which we calculate the "correct" time. It therefore provides a sense of past and future, so that we reckon the time as so many minutes before or after the hour, rather than as a continual accumulation of units. Clearly, clock faces represent time as circular and cyclical, while the digital display gives us a much more linear sense of time.

Digital time is not just a quantitative measurement of time, but also a quantitative concept of time, time as a sequence of numbers, and time as a series of bits of information. And as information, digital time can be processed by the computer, subjected to statistical and symbolic manipulation. Digital time is entirely arbitrary, completely divorced from natural rhythms and human perceptions, and therefore entirely controllable and malleable.

Cybertime is also quicktime. In the age of relativity, the speed of light is the only constant. The electron has set the pace for a century and a half, since the introduction of telegraphy. To the electronic media's instantaneous transmission of information, the computer in turn has contributed the processing of information at electric speed. Consequently, we have come to expect the instantaneous, so that it no longer excites us; we see no need to comment on how fast our messages are delivered through e-mail, but it becomes quite natural to refer to postal delivery as *snail mail.* And we no longer find it very evocative to speak of jet speed, but we become quite conversant in jet lag. When we are sitting at a computer terminal, delays of a few seconds seem interminable, and five minutes an eternity. Cybertime breeds impatience, haste, and intolerance, both on line and in the real world.

The speed of cybertime makes it a powerful technology of synchronization and control. The tendency to place computers in command of events, activities, and procedures has been well-documented and subject to intense criticism (see Bolter, 1984; Roszak, 1994; Weizenbaum, 1976). The computer further extends the use of clocking, introduced in the nineteenth century to control labor and production (Beniger, 1986; Lubar, 1993). And yet, at the same time, the computer's ability to control and coordinate in the interests of speed and efficiency have allowed for more flexible notions of time. The computer introduces the idea of *time-sharing,* initially a process by which mainframe computers were able to accommodate multiple users: Moving at hyperspeed, the computer is able to move back and forth among different users and programs, fulfilling a command here, a line of a program there, balancing a variety of tasks so quickly that the user is barely aware of the computer's divided attention. The introduction of time-sharing to mainframe computers made interactive programming via video terminals possible, and led to the first electronic mail systems; a variation of time-sharing among different computers linked in networks made more sophisticated forms of computer-mediated communication, such as the Usenet news and discussion groups possible (Rheingold, 1993; also see Gelernter's, 1991, discussion of "tuple space"). Elsewhere, the term time-sharing as well as the general principle by which it works has been adopted by the travel industry to create more flexible vacation options, many businesses have adopted the related idea of *flex time* as an alternative to traditional nine-to-five job hours (although this tends to be a smokescreen for downgrading jobs from full time to part time), and in financial markets various forms of programmed trading rely on similar principles (Perkinson, 1995); also, there is the concept of *time-shifting* introduced by the programmable VCR, and brought to a new level by DVRs such as Tivo. Thus, the computer's extreme synchronization results in a more elastic form of time, replacing what Hall (1983) refers to as monochronic time, a linear, one-thing-at-a-time sense of the temporal. Cybertime is therefore polychronic time, which involves many-things-simultaneously; polychronic time is characteristic of many non-Western cultures and, as McLuhan (2003) argues, of electronic cultures.

In order to survive, every society requires a degree of synchronization from its members. For most of the history of our species, the rhythms of nature such as the sunrise and sunset, new moon and full moon, equinox and solstice, were sufficient for this purpose. When temporal technologies such as the calendar and the clock were introduced, however, they by and large served to further control and coordinate the actions of

human beings (Mumford, 1934). The town clock, with its elevated face and its far-reaching chimes, established a local area of synchronized time that served the needs of most western societies from the fourteenth through to the nineteenth century. The invention of the telegraph made it possible to extend this area from the local to the regional in the form of time zones (Beniger, 1986; Carey, 1989). Since that time, the many forms of telecommunications that have been developed, as well as the mass production of increasingly more accurate clocks and watches, have further enhanced coordinated action and procedures.

There is a certain irony, then, to the fact that while our technologies are highly synchronized in their use of time, our societies are still largely working with a nineteenth century system of time-keeping. We all may be wearing extraordinarily accurate watches, but the times that they are set to may differ by as much as ten or fifteen minutes. The solution has already appeared in the form of clocks and watches that align themselves to broadcast time, VCR and computer clocks that do the same, cable boxes that display the time automatically, and now cell phones with their own time displays. In fact, it seems that the sale of watches has decreased significantly recently, a fact that is attributed to the increased use of cell phones as timepieces. The watch has become obsolescent, although it will no doubt continue to be used as a form of jewelry for some time to come.

Cybertime, then, is a highly synchronized time, a broadcast time, and ultimately a global time. Ultimately, I believe there will have to be a single source, a centralized world clock that will govern all cybertime-keeping. And there will have to be a single time frame to synchronize human activity on a global scale. One example of this is Swatch Internet time, which has been broadcast from the headquarters of the watch company in Biel, Switzerland, since October 23rd, 1998. Swatch time is digital, displaying an accumulation of units called beats. It is metric time, forgoing hours and minutes, and instead dividing the day into one thousand beats (beginning with @000, which corresponds to midnight in Biel). This is the first major instance of applying the metric system to time, although there were some unpopular and unsuccessful attempts to establish decimal time following the French Revolution. Swatch time does not correspond to clock time in any obvious way, for example, as I write these words at 9:49 PM Eastern Standard Time, it was beat number @117 Swatch time. This, in fact, makes it well suited for a twenty-four hour society, or as the saying goes, 24/7 (and sometimes 24/7/365). Swatch time is also well suited for providing a global standard. While another system may ultimately displace Swatch time, the emergence of a global standard may well signal the obsolescence of regional time zones. This in turn may allow local time to resurface, so that, for example, the time in New York City would differ from the time in Philadelphia, which is slightly to our west.

Cybertime, as its name implies, is about the control of time, and its colonization. It is about preserving the past in digital memory banks, total recall as it were, but not as the past; the past is recreated and experienced as the present when it is digitized and made available for instant replay. On the other end of the spectrum, the future is brought into the present by programming and simulations. While it would not be possible to achieve this in any absolute sense, the goal is to achieve predestination, and to have the future

governed by the present. In this sense, cybertime is present-centered, as opposed to earlier notions of progress that were future-oriented, and traditional understandings of time that venerated the past as a golden age (for more on cybertime, see Strate, 1996, 2003a).

6. Cyberspace

Since I have made cybertime my fifth bit, it seems only fair to make cyberspace my sixth. Our sense of cyberspace is based on three building blocks. One is the physical cyberspace of the computer itself, and the wires and cables that constitute computer networks. The second is the perceptual cyberspace that is based on our interaction with the computer interface. The third is the conceptual cyberspace that we create through the logical, metaphorical, and rhetorical ways in which we symbolize and represent cyberspace. Together, these building blocks help us to establish what I call second order cyberspace, which includes an aesthetic space associated with form, an information or dataspace associated with content, and an interactive or relational space. Following Hall's model for proxemics, we can identify an intimate cyberspace where the boundaries between ourselves and our technologies are less than distinct, for example when we become caught up in playing a videogame; a personal cyberspace that extends our concept of territoriality to the computer's desktop and files, for example; a social cyberspace where relatively defined groups may interact, such as the instant message and the listserv; and a public cyberspace that is open to all, such as the website and the blog.

These are some of the varieties of cyberspace that I have discussed elsewhere (Strate, 1999). The point I want to stress here is that, just as Einstein explained that physical space is relative, so too is cyberspace a product of relationships, relationships between ourselves and the technology, and most importantly relationships between ourselves and other human beings using the technology. It is through such relationships that virtual communities come into being. Or as Meyrowitz (1985) explains it, media on the one hand, and situations grounded in real physical places on the other, are both information systems. I should add that Lewis Mumford, who is sometimes considered the founder of urban studies, argued that media and communication technologies constitute an *invisible city* (see Mumford, 1961, pp. 563-567).

The city makes for an interesting case to consider. Mumford viewed cities as technologies, a point we tend to overlook because we usually think of technologies as tools, or extensions to use McLuhan's (2003) term. We also tend to forget about container technologies, such as the paleolithic use of skins and shells, and the neolithic invention of pots, bowls, jars, bottles, etc. As media, containers are less like extensions than other types of technologies, but they are more like environments. Moreover, Mumford (1961, 1967, 1970) suggested that tools have a masculine, phallic bias, as opposed to the container's more feminine, maternal characteristics. Without container technology, specifically methods of water storage such as irrigation and wells, as well as innovations such as barns and graineries, we would not have had the agricultural revolution. As surplus production of food created the problem of spoilage, containers provided the solution, and in turn encouraged population growth and concentration. On

a larger scale, other forms of container technology became possible, including fixed dwellings, and permanent settlements such as villages and cities. Mumford (1961, p. 15) refers to the "maternal enclosure" of the village and the city, and along the same lines we speak of the *metropolis* , which etymologically means *mother-city* . As the various forms of container technology made it possible for village communities to evolve into cities, so the city became the ultimate container--as Mumford (1961) puts it, "the ancient city . . . was nothing less than a container of containers" (p. 16).

By bringing together in one location groups of people that had been previously scattered over space, the tempo of human life quickened, the rate of change increased, resulting in the cliché, "the fast pace of city life." Time sped up as it bounced off of the walls of the ancient city. Urban centralization and speed made possible forms of control and coordination inconceivable in tribal cultures, and the impact was not so much explosive as implosive, as Mumford (1961) describes:

The many diverse elements of the community hitherto scattered over a great valley system and occasionally into regions far beyond, were mobilized and packed together under pressure, behind the massive walls of the city. Even the gigantic forces of nature were brought under conscious human direction: tens of thousands of men moved into action as one machine under centralized command, building irrigation ditches, canals, urban mounds, ziggurats, temples, palaces, pyramids, on a scale hitherto inconceivable. As an immediate outcome of the new power mythology, the machine itself had been invented: long invisible to archaeologists because the substance of which it was composed--human bodies--had been dismantled and decomposed. The city was the container that brought about this implosion, and through its very form held together the new forces, intensified their internal reactions, and raised the whole level of achievement. (p. 34)

Mumford argues that the first machines were organic, consisting of the centralized organization and coordination of human labor; only later would the fallible and fragile human parts be replaced by more reliable artificial ones (see also Mumford, 1967, 1970). But what is true for physical labor also holds true for mental labor. Intellectual efforts could be centrally organized and coordinated, for example through concentration in palace or temple. It therefore follows that if the city-as-container could give birth to the city-as-machine, it could also produce the city-as-computer. Of course, in one sense of the word, individual human beings have been functioning as computers long before the development of electronic computers. But if we think of computer technology as not just a substitute for, but an extension of the human brain, the more appropriate analog would be directed and coordinated *collective* cognitive activity. The city is the first supercomputer, the first medium for gathering, storing, and processing information on a scale that transcends individual human experience.

And like the electronic computer, the city-computer could not function without a special, artificially constructed language, a language that would make it possible to program the city-computer. That special language was writing. Writing and cities co-evolved in a relationship as symbiotic as that between computers and programming languages. The closeness of the relationship had much to do with the fact that writing is associated with

container technologies in numerous ways. As forms of storage were developed, identifying marks, a forerunner of true writing, were used to keep track of the contents. Moreover, the first writing system, cuneiform, evolved out of the use of clay tokens which were placed in containers such as clay envelopes for safe keeping. Identifying marks made on the outside of the containers eventually obviated the need for storing tokens on the inside, so that the clay envelopes evolved into clay tablets. Writing becomes a symbolic analogue of the physical container, as well as a system for storing and preserving speech, and information.

Writing made possible the city-states and imperial cities of the ancient world (Innis, 1951, 1972), and the free cities of medieval Europe were founded by some of the more literate elements of the feudal age (outside of church and university), the merchants and the guilds (Mumford, 1938, 1961). In the modern era, printing's relationship with nationalism gives rise to the capital city (Eisenstein, 1979; Mumford, 1938, 1961). The city has always been a center of literacy, so much so that the words "literate" and "urbane" are synonyms, while illiteracy has been associated with the countryside, with the peasants or "folk". Moreover, consider the highest honor that a city can bestow on an individual: a parade during which the hero is showered with writing surfaces--ticker tapes, computer printouts, etc. (Mumford, 1938).

Writing and notational systems led to time-keeping, and eventually to the invention of the mechanical clock. While this technology originated in the medieval monastery (the cloister-container), its early adoption followed the patterns of fourteenth century urban development (Mumford, 1934; Landes, 2000). The clock tower became the symbolic center of the urban landscape through most of the modern era (e.g., London's Big Ben), making it possible to synchronize and coordinate human activities, and thereby allowing for an even faster pace and increased complexity. This was further enhanced by the development of the watch, which itself became a metonym of city life. The very idea of time- *keeping* implies a link with container technology, albeit an abstract one, as the idea is to capture and contain the movements of the heavenly spheres, or their shadows in the case of the sundial; there is also a concrete use of containers in hourglasses and water clocks.

Understanding the parallel between the computer as microprocessor and the city as macroprocessor suggests that electronic and digital technologies have rendered the city obsolescent, an observation McLuhan made back in the 1960s (e.g., McLuhan & Fiore, 1967). For example, consider the concept of the fast pace of city life. Given the value we place on speed, you might say that there is no city like velocity. And not only is it impossible for the city to compete with the instantaneous nature of electronic communication, but city life itself has long since reached its "threshold of reversal" (Ellul, 1990, p. 108), and the pace of urban life has slowed down so much that we no longer notice the irony of "rush hour"--that it is anything but rushed, and that its duration is so much more than an hour. City dwellers may still seem hurried, but they are in fact quite used to waiting in lines, waiting for taxis and buses, waiting for tables in restaurants, waiting for appointments, waiting, and waiting, and waiting.

Moreover, all this waiting is accompanied by a breakdown in synchronization. For example, as travel time in the metropolis becomes more unpredictable, the ability to arrange face-to-face meetings is undermined, and starting times for events become problematic (which leads to further delays for later events). Cities have become inefficient, and cyberspace makes it possible, and often preferable for organizations and individuals to find alternatives. Digital technologies also function as containers, storing data and information in a variety of forms. And like the city, the computer can be seen as a container of containers. Cities will not suddenly disappear, of course, but they are shattered vessels, the inner city decaying or turned into a mall or themepark, while urban sprawl spills out into the suburbs and exurbs.

Ultimately, cyberspace is altering our landscape in a variety of ways. Like the city, the nation-state, which McLuhan (2003) has argued is a product of print culture, is obsolescent. And like the city, the nation-state will not disappear overnight, and given the potential for anarchy, we may not want it to disappear at all. The dream of a homogenous global state was a product of print culture as well, and it has given way to the reality of heterogeneous transnational networks (see Deibert,1997), including multinational corporations, and terrorist networks such as **Al Qaeda.** Increasingly more complex and flexible forms of social organization are inevitable, and with them multiple and overlapping associations may take the place of our contemporary concept of citizenship.

7. The Magic Eight-Ball

I call my seventh bit *the magic eight-ball* , which is a toy that was introduced when I was young. It is an oversized eight-ball, and the idea was that you would ask it a question, turn it upside down, and the answer would appear in a little window on the bottom. I understand that there actually are twenty different answers that come up randomly, such as "signs point to yes" and "outlook good," or "my sources say no" and "very doubtful," or "better not tell you now" and "reply hazy, try again." And you don't have to be a Harry Potter to look into the magic eight-ball, which for our purposes means looking for patterns in the history of technology and culture, analyzing our present situation, and extrapolating out to the future.

For example, we can observe that many habits that were taken for granted in older media environments are now becoming optional, or obsolete. This includes wearing watches, using typewriters and phonographs, tying shoes, and reading the daily newspaper. The same goes for habits such as living in cities, working in offices, going to college, and maintaining a strong sense of affiliation with the "imagined community" of the nation-state (Anderson, 1983). Our social institutions are products of the previous media environments dominated by speech, writing, and print, and they did not suddenly vanish when electricity was introduced. Instead, we have been witnessing a process of transformation that is uneven, sometimes gradual, sometimes sudden, sometime involving minor adjustments, sometimes leading to complete extinction.

For example, we are witnessing a radical change in the concepts of the public and the private. Many have commented on the blurring of the boundaries between the two (e.g.,

Meyrowitz, 1985). The idea that there are certain rules about how one is to behave in public places seems to have given way to the sense that anything goes. This is readily apparent in the way people dress, as articles of clothing once consider entirely private, such as underwear and pajamas, are now considered acceptable for public display. Cell phones are another example, as people engage in private conversations out in the open, and we have no choice but to eavesdrop, an activity once considered secretive. At the same time, support for public, shared spaces and experiences has declined. In a larger sense, we are witnessing the erosion, if not the eradication, of the public sphere.

At the same time, privacy is disappearing. The telephone interrupts us in our most private moments, databases collect information about us, and online our every move leaves digital traces. Celebrities find it all but impossible to keep secrets in the face of constant pressure from the news and entertainment media, but we are all following in their footsteps. While some of us are not comfortable with the loss of privacy, others embrace it. And children growing up in this new environment take it for granted and cannot conceive of any other way of life. The result is a new culture of exhibitionism and self-disclosure, which can be seen in talk shows, reality programs, and online. A great example of this is the fact that diary-writing, which once was considered the most private and intimate of creative activities, is now performed online by teenagers in the form of blogs. And long with the disappearance of privacy, we also lose our sense of shame.

We live in glass houses, but we call them smart houses, online all the time, monitored by home security systems (that are now being offered by cable television companies such as TimeWarner). David Brin (1998) has argued that we are moving towards a *transparent society* , and suggests that we work with the bias and try to establish complete openness, which would lead to complete accountability on the part of government and business leaders.

Certainly, the case of the cell phone is revealing (see Strate, 2003b). It blurs the boundary between public and private, puts us in the position of being always on-call, but also gives us immediate access to others in our social and professional networks, thereby strengthening those networks. Our work world intrudes on our home life, and follows us when we are on vacation, but our domestic life and personal relationships invade the workplace like never before.

Apart from social networks, cell phones constitute an early warning system. Recall the case of the passengers aboard Flight 93 on September 11th, , 2001, who learned about the terrorists' true intentions by cell phone communication, and were able to take appropriate action given the limited options open to them. Following 9/11, many of us in the New York Metropolitan Area felt the need to stay informed in the event of an emergency, and telecommunications services offered to fill this need by sending alerts to subscribers' cell phones.

This admittedly extreme case does point to the fact that once you start using one, you begin to feel naked without one, for example if you forget or lose your phone, or the battery runs out. What if there's an emergency and someone needs to get in touch with me? What if my car breaks down? What if I need help? We are growing accustomed to

living with a digital safety net that includes cell phones, and also global positioning systems that can rapidly pinpoint our location. Systems such as OnStar offer us safety and security for our automobiles so that if we are lost someone is there to give us directions, if we park the car someone is there to keep an eye on it, and if we are incapacitated someone is there to call an ambulance. Medical alert systems are used to monitor the elderly through a device worn as a necklace. Ultimately, though, are we not all at risk, and wouldn't we all want to have our life signs monitored 24/7/365 in case of a medical emergency?

Pets now have chips implanted so that they can be found if they run away. How long before we do this with our children, so that we can find them if they are lost of kidnapped? It is now routine to have your children fingerprinted for the same reason, whereaas not too long ago it would be considered an invasion of privacy. How long before we are all expected to have chips implanted that can provide our medical histories, make economic transactions seamless, and that identify us and track us? This sounds Orwellian to us, of course, but in this eighth digital era it can easily become as routine as the need for *papers* , e.g., passports, drivers licenses, and identification cards, once was. Given the very real danger that terrorism poses, regardless of ideology or motivation, and the solution made readily available by digital technologies, privacy just doesn't stand a chance.

You don't have to be a Harry Potter to see it coming, but you may have to be a Harry Houdini to escape it. How many of us will want to, however, when the trade-off for being online all the time and everywhere is enormous empowerment, an access to information, services, and communication that would, in effect be magical? How many of us will want to when we are living in a Harry Potter world of wizardry?

Error Checking

As the eighth bit in a byte is sometimes reserved for error checking, I have also devoted my last bit to this topic. I am less concerned with the technical process of dealing with noise in a system, however, and more concerned with the human process of evaluation. It is something of a cliché now to speak of information overload, but clearly our problem now is in sifting through the flood of information available, and making sense of it. Perhaps this is why blogs have become so popular recently, and it is certainly true that spam filters are a sign of the times. Moreover, the story of 9/11 provides a chilling example, as all the information necessary to predict the attacks was present, but no one was able to put the pieces together.

It is not just a matter of the amount of information made available, however, but also the form that it takes. This point is brought home in Henry Perkinson's (1995) book, *No Safety in Numbers* . Perkinson argues that the introduction of new communications media lead us to code reality in new ways, offering us a new perspective on our social arrangements. This tends to reveal problems that were previously hidden or ignored, and once they are brought to our attention, we try to solve them. Digital technologies allow us to code the world in numerical terms. As computers set about number-crunching reality following the Second World War, more and more statistics became

available, often revealing risks to health and well-being that were never recognized before. We then set about trying to deal with the risks, but the problem is that risk can never be completely eliminated. So, we are left with the question of how much risk is acceptable. If we can reduce the risk of exposure to cancer-causing substances from twenty percent to fifteen percent, is that sufficient? Is ten percent? There are professional risk analysts who do cost-benefit analysis, but for the vast majority of individuals, the result is an irrational anxiety, so that we have become a risk-aversive society. The fundamental problem is that quantification cannot help us make qualitative judgments. Rather than the triumph of rationalism envisioned by Descartes, we have become hyperrational, which in effect is hardly different from being irrational.

Nor can we find any help in the other symbol system that has come to dominate our culture, the image. From simple cartoons to the most advanced from of virtual reality, image-based forms provide us with experiences, and appeal to the emotions, but they are irrational in the sense that they are analogic, nonpropositional, presentational forms (Langer, 1957; Watzlawick *et al* , 1967). Together, the image and the number have displaced the word in contemporary digital communication, and I would maintain that this is the primary characteristic of postmodern culture (Strate, 1994). And is it any wonder that at the same moment in history when we are experiencing *the humiliation of the word* , to use Jacques Ellul's (1985) phrase, we are also plagued by a moral and cultural relativism that makes critical judgment all but impossible? This is why Neil Postman was a great defender of the word, of verbal communication in both spoken and written form. Language, used wisely, is our only defense against a flood of images and numbers, against the extremes of irrationality and hyperrationality (see, for example, Postman 1985, 1992).

The humiliation of the word is a consequence of living in a technological society according to Ellul (1964, 1980, 1985, 1990), a society where the only value is efficiency. Efficiency is at the heart of binary logic, as base two is the most effective way to reduce choices and narrow possibilities down to a certainty. Of course, reducing choice is hardly a humanistic or humane goal, but neither is it particularly human to represent the base-ten number 100 as 1100100. The binary code is a machine language, with a machine's values. The problem with efficiency is that it is measured in quantitative terms, and therefore hyperrational. We therefore feel compelled to employ the most efficient means to a given end, but this can lead to new inefficiencies and unanticipated problems in other areas. In a technological society, there is only one way to deal with these new difficulties, and that is by applying new technological solutions. This in turn leads to new problems, so that technology grows in a geometrical fashion, which is precisely the way base two proceeds, doubling with each move. In this way, technology becomes autonomous and takes on a life of its own.

We know that we cannot fully understand a system from within, that we need to get outside of a system to find solutions to certain problems within the system, and problems stemming from the system itself. But how do we exit a system that seems to be total and all-encompassing? McLuhan (2003) pointed to the presence of counterenvironments and antienvironments within the system that might provide us with

some perspective, for example art, education, and religion. Perhaps one solution can be found in the number eight.

As a symbol, the number eight signifies the beginning of a new cycle following the completion of an older one. This meaning is derived from the seven-day week, which is a fairly arbitrary designation, if you think about it. Unlike days, months, and years, which are based on the rotations and revolutions of the sun and the moon, there are no weeks in nature. That is why the *Bible* has to legitimize this method of measuring time by linking it to the story of how God created the world in the book of Genesis, and then mandates its observance in the Books of Exodus and Deuteronomy, in the form of the Fourth Commandment to remember the Sabbath day and keep it holy.

As the Sabbath completes the seven-day cycle, the eighth day begins a new week, and from this the number eight came to be a symbol of new beginnings. In England, the eighth day after a feast was called an *octave* , but the more common meaning of octave is in music, where it refers to intervals of pitch in ratios of two to one. For example, going up an octave from middle C the frequency of the note is doubled, going down an octave it is halved. Here too, eight represents the beginning of a new cycle, as in *do re mi fa sol la ti* , which brings us back to *do* .

This fits the theme of the *Bienal* , which makes reference to the beginning of a new cycle, in this case a new century. Moreover, it makes reference to the end of a smaller cycle, the new century's first *lustrum* . The word lustrum is rarely used in English, and considered obscure; consequently, we attach no special significance to five-year periods of time. But in ancient Rome, a lustrum was associated with a census taken every five years, which was followed by a ceremonial purification. The lustrum is similar in some ways to the Biblical commandments specifying that every seventh year be a Sabbatical year in which farmland must remain fallow and debts be forgiven. From this we get the academic sabbatical, during which time our intellects are supposed to recover their fertility. In the *Bible* , the fiftieth year following seven seven-year Sabbatical cycles (i.e., forty-nine years) is a Jubilee year, in which, in addition to the regular Sabbatical requirements, hereditary properties are restored to their legal heirs, and servants are emancipated.

Cycles such as the keeping of the Sabbath day, lustrum, and Sabbatical and Jubilee years provide opportunities to pause, take stock, and contemplate. It is precisely this capacity for reflection that we have lost as we have replaced natural rhythms with logarithms, and moved to a 24/7/365 society. It may not be feasible to ask for a Sabbatical from technological innovation and change, but that is certainly what we need.

Another manifestation of the number eight comes to mind. The year that I turned eight, 1965, a television cartoon called *The Eighth Man* aired in the United States for the first time. It was a Japanese anime, dubbed in English, and t he series opened with a government agent being gunned down by gangsters. He was fatally wounded, but was fortunate enough to be found by a scientist who was able to transfer his mind into the body of a robot. He was especially lucky because the scientist had tried to do this seven times before, and each previous attempt had failed. Thus, he became the superhero

known as the Eighth Man, also calling himself Tobor, which is robot spelled backwards. The concept of a human mind existing within a robot body is an interesting metaphor for human existence within a technological environment. And it suggests the possibilities of new forms of consciousness.

Walter Ong (1982) argues that human consciousness evolves, and it does so as it internalizes new modes of human communication. We can expect that the internalization of digital media will lead to new forms of consciousness, and hopefully, forms of consciousness better able to cope with our technological systems. Our new media environment is characterized by a kaleidoscope of technologies, by a heterogeneous mix of oral, literate, visual, and tactile modes of communication and perception. This has been undoing the homogenizing effect of print media and, I would suggest, is opening the door to the coexistence of alternate modes of consciousness. This is reflected in Timothy Leary's experimentation with psychoactive drugs in the sixties, however dysfunctional that may have been, and in his embrace of virtual reality technology in the nineties. It is reflected in the popularity of transcendental meditation in the seventies, and the ongoing interest in New Age spirituality. It is also reflected in what many are now calling an epidemic of autism. While we parents look upon this with alarm, high functioning autistics object to the idea that their condition is a disease that needs to be cured, or even a disability that needs to be overcome. Instead they argue that theirs is a different mode of consciousness.

Although we may find a greater variety of consciousnesses in the future, not all will survive. Certainly, it seems that the tribal consciousness of oral cultures will continue on its march to extinction in the face of advancing technologies. But as some of literacy's effects are undone, we may see a return to a more oral-like consciousness, for example in the tendency to think less abstractly, more concretely and visually, and to become less distanced and objective, more emotionally involved with our world and our fellow human beings. I would also expect to see literacy's extreme individualism undone. We will not return to the simple group identity of oral culture, however. Instead, many of us now find ourselves in numerous relationships as we maintain contact with others through telephone, e-mail, instant messaging, and cell phones, in addition to more traditional modes of communication. We have more relationships with more individuals today than at any time in our history, creating more selves and a more fragmented and complex inner life. Postmodernists talk about the decentering of the subject, and psychologist Kenneth Gergen (1991) calls it the saturated self, but in another sense we are internalizing the heterogeneity of today's collective consciousness. The result is a less homogenous and uniform individual consciousness. I don't mean to suggest that the outcome will be some form of schizophrenia, simply a new form of consciousness that reflects the chaos of the electronic media environment. It is a consciousness built upon constant, rapid sensory stimulation occurring along multiple sensory channel simultaneously. McLuhan (2003) argued that the old linear mode of thought could not meet the demands of this new environment, and that we needed to develop new modes of pattern recognition to make order out of chaos. Pattern recognition, along with an internalization of the more recent concept of multitasking, would be integral to a new type of electronic consciousness.

I have alluded to the fact that the electronic media have removed many of the repressions that literate consciousness put into place. Certainly, we don't seem to be motivated by guilt or shame, at least not in the same way that literate and oral cultures were in the past. But in particular, I believe that the undoing of literate repression is putting us in closer touch with the unconscious mind both individually and collectively. In oral cultures, there was less of a barrier to the unconscious, allowing individuals to retrieve archetypes and enter the dreamtime with relative ease. But they did so in an unreflective, unconscious manner. Having strengthened the conscious mind through literacy, we can now use the electronic media to engage the unconscious mind in a self-conscious manner. We are continually exposed to our dreams, and our nightmares, through television and film. And we are discovering that there are many more monsters from the id online than we ever suspected. But we are confronting them while fully conscious. I therefore think that the possibility exists that we may find a way to integrate the conscious and unconscious minds, to embrace and absorb the shadow, the anima and animus, as Carl Jung (1971) referred to the components of the unconscious. Jung believed that such integration would leads us to the next stage in the evolution of consciousness, and it may be that this will happen as we interiorize our electronic communications. However one feels about Jung, it does seem that our survival as a species may depend on our ability to raise our consciousness to the next level. We also seem to be moving toward a new form of collective consciousness. I don't think it is quite the same as Teilhard de Chardin's noösphere, although there does seem to be a spiritual dimension involved, at least as reflected in the renewed interest in spirituality in our time. But rather than a noösphere, it is a networked consciousness that we are creating, and internalizing as a new ecology of mind (Bateson, 1972).

This is speculation, of course, and ultimately the magic eight-ball gives us the answer, "reply hazy, try again." There are limits to our knowledge, and limits to our ability to predict the consequences of our actions, and especially the consequences of our adoption of new technologies. Until we evolve radically new modes of consciousness, I believe that our best hope lies in what Neil Postman called media ecology education. I have discussed media ecology formally and systematically elsewhere (e.g., Strate, 2004), and have not attempted to do so here. Suffice it to say that we need to understand how we use technology to manipulate and modify our environments, how we use technology to mediate between ourselves and our environments, how we use technology as environment, and how we are in turn shaped and influenced by these environments that we have made. Media ecology is, in my opinion, our best hope for error checking. And with this, my byte is complete.

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