Zero Effect:
The Year 2000 Computer Crisis

F Allan Hanson

Around the year AD 1000, Hindu scholars developed the concept of zero. Their recognition of this expression of nothing opened the way to virtually all subsequent developments in mathematics. Ironically, a millennium later, failure to recognize something about zero has produced a "Year 2000 computer crisis" that threatens to close down many of the automated systems that have become essential to contemporary life. A further irony: it is a situation that we, by temperament and by culture, are peculiarly ill-suited to address.

The problem is that computer programs which record only the last two digits of dates (e.g., 98 for 1998) are unable to make accurate comparisons and calculations with dates falling after 2000. The computer may be unable to process 00 at all, or may read it as 1900 rather than 2000, ninety-nine years *earlier* than 99 rather than one year later. The result will be program crashes or huge errors. Credit card payments will be rejected with the explanation that the card expired nearly a century ago, insurance policies will be erroneously canceled, bank statements will show accounts to have accrued millions of dollars of interest, or to be millions of dollars overdrawn. The problem affects manufacturing, energy, communications and financial industries, and, indeed, virtually every enterprise dependent on computers world-wide. One commonly cited projection is that the global cost for repairs and replacements will be in the neighborhood of $600 billion; a spate of lawsuits is expected to add substantially to that figure.

Responses to the Y2K (shorthand for Year 2000) problem run the full gamut. At one extreme are those who dismiss it as a phony racket by computer consultants and lawyers bent on making a buck from a gullible and frightened public. At the other are survivalists who are stockpiling food, water and guns in remote fortresses, where they plan to weather the crisis and repulse the starving hordes who will be caught unprepared for a general breakdown of society. The most common reaction, however, has been complaisant disinclination to believe that this can be a serious problem. In large measure this is because it is unprecedented. We tend to understand things in terms of their resemblance to other things, and the Y2K problem is unlike anything in our experience. More than just a technical issue, it is rooted in the particular sort of relationships that have developed between humans and computers, and among human individuals and organizations. This article explores those relationships from a cultural perspective in order to understand the origins of the Y2K problem and what is being done about it. The latter issue has practical relevance because there is a sharp discrepancy between the most effective way of addressing the problem and what is actually being done.

The Mind-Affected World

The German philosopher Wilhelm Dilthey applied the term "mind-affected world" to everything that is made, modified, or arranged by human beings. This encompasses a very large part of the environment that most of us inhabit most of the time. Inside any building, or in any town or city, literally everything we see, hear, touch, taste or smell except the air itself (considering air conditioning and pollution, that too) is mind-affected.

The origin of the Y2K computer problem is rooted entirely in its status as part of the mind-affected world. It is an artifact of highly conventional methods of time-reckoning. To be sure, a calendar year bears a relation to the revolution of the earth around the sun, but nothing natural grounds the custom of organizing years into decades, centuries, and millennia. These are outcomes of our base-10 numerical system. While that probably derives from the fact that human beings have ten fingers, it is by no means inevitable that years and other quantities must be calculated to the base 10. Ancient Mesoamericans used a base-20 system, while ancient Mesopotamians counted to the base 60.

Moreover, nothing in nature, nor even in a base- **10** numerical system, mandates that it will soon be the year 2000. In the Hebrew calendar, for example, January 1, 2000 falls in the year 5760. That we stand on the threshold of a millennium shift, and that the moment of transition will occur in the middle of a northern hemisphere winter, is the result of purely historical considerations such as the significance of Christ in the Western tradition and a number of arbitrary decisions made at various times in devising the Julian and Gregorian calendars.

Despite all our efforts to make it such, the mind-affected world is not invariably a docile servant that embodies our intentions and works to our benefit and convenience. Sometimes it gets out of hand. This is obvious for the Y2K computer problem, and also for graver situations such as environmental degradation and the specter of nuclear holocaust. For all such predicaments, nothing except further human intervention is available to contain and repair the damage. Hence in the contemporary human/environment relationship, the environment is not only significantly created by us, but we also bear responsibility for its maintenance. One part of the mind-affected world where that responsibility has been neglected has to do with computers.

Computers and Us

People usually think of computers as tools. They help achieve tasks that, without them, would be far more tedious and time-consuming or even, as with instantaneous global communications on the Internet, impossible. Sometimes computers are promoted from the status of tools to that of partners. Or, perhaps better, humans are demoted to the status of yet another toot. It is trendy to call computer users "peopleware" or "humanware." This evokes an image of humans as merged with computers--an additional ingredient blending with hardware and software to serve the ultimate goal of the efficient and rapid production, storage, and exchange of information.

If people are sometimes viewed as components in the computing process, it is also true that computers are regarded as human. Ever since Apple introduced the Macintosh in 1984, the guiding principle in personal computer design has been to create "user friendly" operating systems at the human-computer interface. In her eye-opening book *Life on the Screen*, Sherry Turkle explores how this encouraged people to treat computers more like other people than like machines. Computers behave much like ourselves. They flash friendly words of greeting when we boot them up. They communicate with us in plain English, they respond to straightforward directions, and seemingly they carry out their work in the same ways that we do. We play games with them, and they often win. Although they are not considered to be alive, Turkle found that people increasingly attribute personalities to computers, and the ability to think.

But the outstanding characteristic of the Macintosh and (to a lesser extent) Windows operating systems is that the handy icons and simple commands conceal the computer's inner workings from the user. The human-computer interaction takes place entirely on the surface, the user having no idea of how the computer actually accomplishes the tasks it is given. With developing technology, in some cases computer operations are becoming so complex that virtually no one understands them. Thus the notion that computers think like we do is an illusion, as we discover in exasperation when they lose our files, display screens filled with garbage, or just freeze up and refuse to respond at all.

The Y2K problem is perhaps the first serious crisis to emerge from the mistaken assumption that computers think like humans do. A major frustration for those who try to spread the news about the Y2K problem is a strong disinclination of people to believe it. One reason for this is a widespread lack of understanding of the difference between human and computer data processing, and the much greater limitations on computers. How easy it is for a human being to understand that the year intended by the digits 02 is 2002; why should it be so difficult for a computer? After the problem has been grasped, the next reaction is to imagine that there must be some quick fix that will solve it with relative ease. Again, this is born of the tendency to think of computers as similar to ourselves. Human beings tutored in basic arithmetic do not instantly grasp that subtracting 99 from 01 gives a result of 2, but when they learn the convention of adding the first two digits of 19 or 20, they quickly get the point. Why should a conversion so simple for us require so much tedious reprogramming for computers?

When people finally realize that there is no silver bullet, that the modification of the world's computer systems to handle the crossover from 1999 to 2000 requires massive replacements and the painstaking examination of billions of lines of code, their next reaction is to be dumbfounded. The problem should have been obvious to anyone who would take a few minutes to think about it and, indeed, it was. But programmers two and three decades ago indicated years with two digits to save precious memory space, blithely assuming that their work would be replaced long before the year 2000. Many of those programs are still in operation, however, and what is most incredible is that certain new programs and upgrades released within the last two or three years still use the two digit year field. How can this be?

Obviously, people have not been addressing a clear and nearly-present danger. In some cases the reason may be that software vendors anticipate further profits when users are forced to buy Y2K compliant upgrades as the millennium approaches. (What they may not have anticipated are the lawsuits that are already being slapped on them for fraudulent business practices.) In other cases the neglect may be benign. Perhaps people have become so accustomed to interacting easily and constantly with computers that they forget their limitations, complaisantly imagining that computers will be able to negotiate the millennium shift as easily as humans can. In either event, the lesson to be learned from the Y2K crisis is that, while we indeed are intimately linked with computers in networks of interdependence, the human mind remains the highest processing center of information. Other parts of the systems are less equipped to analyze variables, evaluate contingencies, project possible futures, perform, in general, the highest level of cognitive functions. The human mind has the responsibility to do this, and to know that it must do it.

The Y2K computer problem is, as I have said, the first crisis to emerge because we have forgotten that responsibility. While it is a major threat in practical terms of system failures, lost productivity and expense to repair, logically speaking it is simple to the point of being trivial. The nature of the problem is readily grasped by almost anyone. Perhaps more important than anything else, it is a warning of what could happen if we do not reassert human vigilance and control over information processing. If problems should develop in elements of hardware and software that are complex beyond the understanding of nearly everyone, solving them will be infinitely more difficult than Y2K. The human track record in letting the Y2K problem happen is not impressive. Unless we learn from the experience, the future does not look promising.

"We have seen the enemy .... "

The Y2K problem is further aggravated by the kind of relationship prevailing among human organizations. The core assumptions that govern business, legal, and other relations in contemporary society derive from two highly influential books: Adam Smith's *The Wealth o/Nations* (1776) and Charles Darwin's *Origin o/the Species* (1859). From Smith comes the idea that the general good is to be achieved by each individual pursuing his or her private interest. Hence the emphasis on free enterprise and distaste for regulation of private businesses seeking to maximize their profits. Darwin's contribution is the notion of evolution by natural selection. The more fit individuals survive and reproduce at a higher rate than others, thus shaping the evolutionary development of the species by passing their traits on to future generations. Translated from biology to the social world, this is the idea that individuals, corporations, nations, and other social entities engage in competition with each other, and those best adapted to the prevailing conditions are most likely to survive and flourish. Combining Smith and Darwin produces the particular view of the marketplace--of goods, services, ideas, or whatever--as an arena in which the general good emerges from competition among contestants, the best adapted of which are most likely to succeed. Of course completely unrestrained capitalism has been tempered with controls and regulations designed to preserve fairness, but in general this image remains our simple, rule-of-thumb notion of how things work in the real world.

From this perspective, it is possible to think of the Y2K computer problem as one of numerous cleansing ordeals that define the conditions of persistence and change. Organizations with computer systems that are Y2K compliant will weather the millennium change successfully, gain a competitive advantage and emerge stronger than before. Those with serious problems will either fail, or will modify their computer systems to become Year 2000 compliant. In either case, after a period of stress and instability, maladapted elements will have been pruned away, and the social and economic system will have taken a step forward. While perhaps traumatic or even lethal for the less fit, such is the hard reality of how society, in common with biological species, copes with changing conditions, survives, and improves. However, this is the worst possible construction to put on this particular problem.

The contemporary global village (Marshall McLuhan's apt phrase) is anything but a gladiators' arena where individual competitors engage in free-for-all competition to determine who will survive. It is rather a system of networked interdependence. Different companies, governmental agencies, and other organizations are linked by complex relationships of communication, regulation, supplying, contracting and subcontracting for goods and services of all descriptions. This requires the exchange of immense amounts of information, which is accomplished with

lightning speed by means of computers. A breakdown in any link in the chain of communication may have far-reaching effects. In January, 1998, computer users in Sri Lanka were unable to access the Internet when a huge ice storm curtailed operations of a provider service based in Quebec. On May 20 the malfunctioning of a communications satellite disabled nearly all of the pagers in the United States and forced television and radio networks to reroute their transmissions.

The Y2K problem poses a major threat to the interdependent network. Electric power plants and telecommunications may be disrupted, the transportation of goods and people interrupted, transactions between financial institutions may be affected, invoicing and payments could grind to a halt, payrolls might not be processed, insurance premiums and loan payments not made. With increased reliance on rapidly transmitted, accurate information, recent trends such as "just in time" supplying and manufacturing exacerbate the threat.

Successful coping with the Y2K problem requires the maximum flow of information. Only then can those charged with fixing it know precisely what systems to address first and how to address them so that the repair will be compatible with other systems with which they interact. As economist Edward Yardini said, "this is a communal problem that needs a communal approach."

Not surprisingly, organizations of all sorts are anxious to know the status of their trading partners with reference to Year 2000 computer compliance. They send them letters and questionnaires requesting detailed information about how serious their problem is and what progress they have made in correcting it. The responses, however, tend to be cagey. Fearful of making statements that might in the future be regarded as warranties that did not hold up, and thus of opening themselves to liability and litigation, many companies respond to such queries, when they respond at all, in hedged, vague terms. Moreover, divulgence of vulnerabilities in the Y2K remediation process could signal weaknesses that might encourage competitors to take advantage, or make the company a target for predatory take-over. Hence it is standard practice to disclose as little information as possible. Ed Yourdin of the Cutter Consortium said "Everybody is trying to demand warranties and guarantees from their vendors and suppliers, but vendors' lawyers are saying, 'Keep your mouth shut.'" The advice seems to be having its effect. Efforts by the General Services Administration to create a database with Y2K compliance data for various software products are being hampered by vendors' reluctance to provide information. A survey of 1000 filings with the Securities and Exchange Commission revealed that 32 percent of electric and telecommunications companies (two of the industries where Y2K-related breakdowns would have the most devastating effects) did not disclose any meaningful information about their Year 2000 project status.

The deleterious impact of secrecy on efforts to deal with the Y2K problem is raised almost to the level of caricature by a recent development in the Department of Defense (DoD). The Defense Integrated Support Tool (DIST) is a database containing information on some 9000 computer systems throughout the DoD. As a central source of information about interfaces between different DoD systems, DIST is important for Y2K remediation projects. In February, 1998, the National Security Agency decided that the information contained in DIST is highly sensitive. They classified it at a level where most DoD personnel working to fix the Y2K problem no longer have access to it, making it impossible for them to carry out their remediation effort.

The Self and the Other

The element of the Smith/Darwin model most directly responsible for such defensive, adversarial responses to the Y2K problem is a view of the relation between self and other that may be termed "oppositional." Its distinctive feature is a bright line separating Self from Other. The human individual or group is segregated from its surroundings, consisting of the natural environment and other individuals or groups.

The Self, on this view, is frequently considered to be not only distinct from the Other, but also opposed to it. This oppositional vision of the human condition has acquired great significance in modern culture, for it is precisely by contending with the Other that the Self defines and evaluates itself, tests its resources, applies its abilities, and measures its endurance and courage. The familiar values of individualism, integrity, teamwork, and loyalty are rooted here. Parables dramatizing them fill literature, popular lore, and daily life: the climber testing his limits against a rock face or mountain, the scholar struggling against obdurate subject matter and ambitious rivals to achieve a new discovery or conceptual breakthrough, one football team striving to defeat another, one army striving to destroy another. Situations of these sorts embody much of the challenge and meaning in life for modern man. They define human courage, aspiration and achievement, and they set the scale of success and failure, honor and dishonor.

The oppositional notion of Self versus Other may have fit certain conditions of life in the past. One example might be the westward expansion and frontier life in eighteenth and nineteenth century North America. In those circumstances it made a certain amount of sense for settlers to imagine themselves as pitted against indigenous rivals and recalcitrant nature to take control of the land and force it to submit to cultivation. Colonialism is another, quite similar, situation.

But this way of thinking no longer fits the realities of the present. We cannot insulate ourselves from the other because the entire distinction between us and the outside world, Self and Other, has broken down. Meshed together in the network of interdependence, human beings are no longer conceptually separable from their surroundings. What Bruce Mazlish called the fourth discontinuity--the gap between humans and machines--has been effaced. Mechanical extensions of our individual or institutional selves--automobiles, computers, telephones, fax machines, pagers—inextricably link us with other persons, objects, and organizations. So integral are they to what we do and what we are that we could not function without them. It is even difficult to determine precisely where we end and they begin. What is obvious for those with pacemakers or prosthetic devices is, upon reflection about how helpless we would be without these extensions, equally true of all of us: we have become cyborgs, part organism and part machine.

Nor are social relations any longer accurately captured by the notion of clearly definable in-groups (clans, villages, or teams) characterized by internal solidarity, support, and opposition to other such groups. Interaction in the global village commonly operates through diffuse and sprawling networks. Businesspeople, scholars, and others may have little to do with their next-door neighbors or closest relatives but depend upon and interact regularly with people from other continents whom they will never meet.

Nothing could be less appropriate to the present reality than the oppositional conception of the Self as distinct from and opposed to the Other. If we are to operate effectively in this reality, we must blur the distinction between Self and Other and accept responsibility for the whole. That requires replacing the oppositional view of the human condition with another one better suited to actual circumstances.

In *Steps to an Ecology of Mind*, anthropologist Gregory Bateson suggested a plausible alternative, which may be termed interactive. He conceptualized the ecosystem as an interconnected network that operates by communicating messages between its constituent parts. His basic precept is that, when confronting any situation in which messages are exchanged, the boundaries that define the units of analysis should be drawn so as to encompass the lines of communication and never to cut them. Consider a blind person walking along a sidewalk with a stick. Do not think of it, Bateson proposed, as three distinct entities--the person, the stick, the sidewalk---engaged in a certain sort of interaction. Instead, think of the whole complex--person/stick/ sidewalk--as a single unit, a cybernetic system within which the communication of messages enables adjustments in the actions of the constituent parts. Thus the stick transmits messages through the hand and arm to the person's brain about the condition of the sidewalk. The brain evaluates that information and sends messages to the legs about the next steps to be taken—go straight ahead, step up on a curb, move around an obstacle, or whatever. With that the stick receives new information from the sidewalk and transmits it to the brain, which processes it and decides about the next steps to be taken, and so on.

A similar analysis can be made of a blind person negotiating her way with a seeing-eye dog, two or more persons engaged in conversation, a game of chess, or any other activity. Depending on the particular situation, the component parts of the communicative unit will vary in number and kind. Some of them are mere transmitters of information (the sidewalk, the stick, a chessman on a certain square), while others process information at various levels of complexity. Thus two processing or decision-making centers are in play when a blind person uses a seeing-eye dog: the dog's brain and, at a higher level, the person's brain. Two processing centers are also involved in a game of chess, this time both at the same hierarchical level.

From this perspective, units of analysis are not discrete human individuals moving in their sameness from one encounter to the next. Instead, they are fluid, ephemeral systems of communication of variable description, size and complexity that emerge, metamorphose, and disappear with particular instances of interaction. The blind woman participates in one system of communication when she goes from the classroom to the library with her seeing-eye dog, another when she reads a book in braille in the library, and a third when she plays chess with a friend.

Interdependence, Creativity and Responsibility

The interactive way of thinking differs most importantly from the oppositional concept of the subject by not setting the Self against the Other. It replaces encounters of contention with fields of interdependence and pathways of communication. This suits the reality of networked interdependence in a way that the oppositional view does not. The latter view is built on the assumption that overcoming the Other results in a net gain for the Self. This is palpable nonsense in the context of, say, the nuclear stand-off, where mutually assured destruction means that

overcoming the Other equals the demise of the Self. This situation is more accurately described as a precarious, single system liable to self-destruction if certain sorts of messages are communicated between its component parts. A similar argument is easily made for environmental degradation: human domination over the environment is self-defeating, for its result is not a net gain for humanity but degradation of the ecosystem as a whole, of which humanity is a part.

It is the same with the Y2K computer crisis. Minimizing its damage requires full communication of information. Businesses, governmental agencies, and organizations of all descriptions need to learn from hardware and software manufacturers and vendors the Y2K compliance status of the many automated systems they rely on: their custom-designed software, the off-the-shelf products they have purchased, their heating, ventilation and air-conditioning systems, sprinkler systems, security systems, elevators, medical and laboratory equipment, and any other equipment that may have time-sensitive embedded chips. They also need to exchange Y2K compliance information with their suppliers, shippers, customers, bankers, and other trading partners, for failure of any one of them could disrupt many others. But, as explained already, anxiety about liability, litigation, and divulgence of trade secrets generates a widespread reluctance to disclose information about the problem. This is a classic example of the oppositional relationship of Self and Other. But in terms of coping with the problem, nothing could be more self-defeating, for communication is cut off precisely when and where information exchange is essential for effective corrective measures to be taken.

The Y2K problem is serious, and costly, but it is not Armageddon. It will be solved sooner or later. The point of this analysis is that the more companies and other organizations succeed in extricating themselves from an oppositional, competitive mode, which is totally inappropriate to the sort of problem Y2K is, and approach it cooperatively, the sooner it will be solved and the less havoc it will cause.

Efforts are being made to encourage the exchange of information. The Securities and Exchange Commission is stiffening requirements that publicly traded companies disclose material information about their Year 2000 status, and other regulatory agencies are mandating similar measures The Year 2000 Information and Readiness Disclosure Act, designed to provide limited protection from liability for statements about Y2K matters, was signed into law by President Clinton on October 19, 1998. While these measures are likely to go some distance in breaking the logjam of communication, a spirit of true cooperation is hardly the sort of thing that can be forced. In a recent article in the *Houston Law Review* J.B. Ruhl argued (in the context of environmental law) that rigid and coercive measures such as regulatory rules and legislation are not likely to be effective in the long run because they are themselves part of the oppositional mindset that produced the problem in the first place.

Perhaps more promising are the voluntary user groups of information specialists from a wide variety of organizations that meet regularly in many communities to discuss their Y2K problems and share solutions In a similar vein, the Big Three automakers (Chrysler, Ford, and General Motors) have joined with the Automotive Industry Action Group (a trade association) to assist suppliers with conversion problems by sharing Y2K knowledge and resources. However, efforts such as these may not be extensive enough to make a significant difference.

Any general shift from an oppositional stance to an interactive one more suited to contemporary realities would have to overcome immense cultural inertia. The oppositional perspective is deeply implicated in fundamental assumptions about the definition of Self and Other and the relation between them, what constitutes success and failure, and the source of meaning in life. We have already noted how, under the oppositional view, human aspiration and achievement are articulated in the context of a struggle between the Self and human and natural Others. That vision of challenge, triumph and failure is foreign to the interactive image of the human condition. Therefore a successful transition to the interactive perspective would necessarily include redefinition of what constitutes important and meaningful human activity.

It is not particularly difficult to imagine what such a redefinition might look like. The interactive view would shift the source of meaning in human life from triumph and domination to comprehension, creativity, cooperation, and responsibility. In the contemporary interdependent networks linking computers and other machines with human individuals and organizations, human minds are the most powerful decision-making points. This is where incoming information is not processed in purely pre-programmed ways, but where the highest-order evaluations are made and the most novel outputs may occur. Such networks lack centralized control, but human minds operate in them rather like the several nerve intersections or ganglia that take the place of a brain in invertebrate animals. The ganglia act cooperatively rather than competitively. Otherwise the animal, or the computerized network, would work at cross-purposes with itself.

If such an interactive perspective were to be adopted, success and failure would be defined in terms of the uniquely human capacity to create and understand the complex, interdependent networks that constitute the mind-affected world, and to cooperate in their management for the well-being of the whole. That view of the human condition is far more appropriate to contemporary reality than the tired, outmoded perspective of opposition and competition. However, our species has not historically distinguished itself for recognizing new states of affairs and voluntarily transforming itself in accordance with them. It is not easy to imagine that we will do so now.

SUGGESTED FURTHER READINGS

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E Allan Hanson is professor of anthropology and distinguished lecturer in humanities and western civilization at the University of Kansas. His primary interests are social theory and the

impact of technological developments on contemporary society. Among his books are Meaning in Culture and Testing Testing: Social Consequences of the Examined Life.