In this issue, we bow to the overwhelming flood of information about the overwhelming flood of information that is taking the the human systems by storm.

The February 12, 1982 issue of *Science* is devoted to an overview of the current computer and electronics revolution. It examines the steady increase in the number of circuits that can be placed on silicon chips and the concomitant decreases in the costs of logic and memory. Reliability per circuit is now 10,000 times better than it was 25 years ago, according to Phil Abelson, *Science* editor. Declining hardware costs and soaring software costs mark today's phase of the electronics revolution, the major reason Abelson cites being that the logical complexity of software typically far exceeds that of hardware. Almost every other periodical that purports to be in any way "of record" has taken some note of the computer revolution. Its promises are dazzling.

As in all uses of energy, entropic fallout will occur. Where the Industrial Revolution's negative (entropic) fallout has been most noticeable as degradation of the environment, entropy from the vastly speeded and expanded electronic information organiza tion could balance this scale—a dubious accomplishment that would express itself in terms of heightened human aggravation, a turning of already painful social screws.

The exact nature of the entropy which will be generated by the information explosion will follow the "rule of unpredictability" that always applies in the case of "emergent properties" following any new heirarchy of organization. The wrenching of people from established jobs, with all the accompanying anxiety, is predictable because it is already here.

This downbeat assessment is referred to by Abelson as "the ancient tensions between rich and poor...between those with high intellectual capacity and the less gifted...and between the well educated and the untrained. Problems will develop with fixation on entertainment and possible misdirection of computer systems for antisocial purposes."

The other face of all this includes the possibility that computers can help "smear over" the existing differences in human intellect by making it possible for people to learn at their own speed. When the interaction is only between a computer and a learner, the differences in learner intellects become mainly one of time—the time necessary for the individual to master or internalize the subject matter. Since this is a matter that need be only between the person and his electronic teacher, certain raw classroom edges can be smoothed and psychological wounds avoided.

In any event, people tend to be optimists, and the light side of the computer revolution is intriguing and inviting. One recent morning, on public radio, I heard an interview with a big league

pitcher who had jetisoned his roomful of notes about various batters he regularly faced. For this load of paper he had substituted a 7-inch computer disc, containing all the information that had been in his notes. At the touch of a button, the computer flashed on his screen the appropriate information about any batter; he no longer had to plow through a pile of written information or depend on his own memory for the best pitching approach.

When asked if this weren't a bastardization of the game—or an unfair advantage—the pitcher in question suggested that soon now baseball dugouts would be equipped with computers programmed with all the information a manager and his players could conceive of as having an effect on their chances of winning. When a particular situation arises, the computer will synthesize all possible courses of action and, within seconds, come up with the optimum chance of making a gain.

The players, he pointed out, STILL will be faced with the actual playing situation, but their APPROACH presumably will have maximized the possibilities for success.

Obviously, a huge, well-nigh irresistible social change is taking place. With movies like TRON, where humans themselves become electronic game components, the whole world can be viewed as one vast game. The software and hardware of computers represent the new stage where our human actions are intensified, speeded up, extended, and drained of certain baffling and time-bound complexities, while at the same time we are being forced to deal with new complexities whose outlines we can only dimly discern.

A whole new generation is reaching adulthood with a vastly heightened sense of the interactive processes of environment, economics, and ethics and with a dawning realization of what these three areas mean as each moment ticks off a changing quality of life on this third planet out from the nearest star.

The Third International Conference on State of the Art Ecological Modeling (at Colorado State University) continued to work on the cutting edge of modeling, including entire ecosystems and their interfaces with the economic systems that ride them. Systems modeling, with computer printouts or screens, help people recognize the error of such current concepts as "side effects," showing instantly and graphically that ALL results of any action are EFFECTS—equal contributors to the world that is emerging moment by moment.

Having looked at some of the plusses and minuses, we find the fact to be reckoned with is the incredible growth of the computer network. This has occurred despite the high costs, heavy hardware, and low benefit yields that marked the earliest and costliest days of the phenomenon. Its growth has permeated indus-

try, business, research, social planning, entertainment.

Out of this mixed bag of observations comes one indisputable, underlying truth about human beings: they absolutely demand information. They live it, they play with it, they will pay whatever is necessary to bring it into their lives—at whatever levels they choose to live their lives. These levels range from the Game Arcades to the theoretical laboratories of Earth, and life in both places, and everywhere in between, is never going to be the same again.

A cartoon on a bulletin board outside the computer terminal room at Oregon State University shows a couple of computers watching a professor approach. "Try to look dumb," says one of the computers. "Here comes the human factor."

Actually of course, it is the human factor alone that is important. We could begin to feel like the toy players in some arcade computer game, merely acting out the parts that don't have to be plugged into a wall somewhere. But the truth is not so easy on us. We are the controlling factors. We took a wheel, put it on an automobile, and wound up with a society built on cars, highways, and fossil fuel dispensers called gas stations. A combination of the automobile and gasoline shaped our society, in the same way that Winston Churchill observed our buildings did. We shape our buildings, Churchill said, and then our buildings shape us. This has been the evolutionary history of humanity—buildings, automobiles and now computers being only the latest three in this interactive process of people and world.

Just as it was impossible to imagine the environmental and social consequences that would stem from that first model T, which brought mass automobile transporation onto the scene, so we can only dimly discern the future that may unreel from our computer tapes. With the addition of computers, the accumulated human wisdom and perceptions whose storage and retrieval have been so faulty in the past may find a way to pull abreast of our complex technology. If so, we might be able at last to reverse the trend so well expressed by Ralph Waldo Emerson: "Things are in the saddle and ride mankind."

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