As a child one of my prized possessions was a book about atomic energy, issued about six months after the Hiroshima bomb. The book had statistics about how many times a car could go around the world on a gram of uranium, how New York City could be supplied with electricity almost forever with a few ounces of plutonium, and other ‘atomic age wonders.’ According to the dust jacket blurb, there were drawings “by leading scientists, engineers, and architects,” which showed domed and climate controlled cities where moving sidewalks connected towers, and where people of all ages flitted around using back pack helicopters. This was all to come about by 1960 or 1970.

As I read articles by Third Wave prophets of computer controlled futures, I am reminded by my treasured childhood book and of other equally utopian writings for adults. True, there is not a direct analogy between atomic energy and computers. Computers do not need massive shielding, they are accessible to anyone with enough money, and they are not fatal—although they can direct weapon systems. Still, the claims of computer boosters must be taken with a grain of salt. There are many reasons why computers might not become common household tools, or even common classroom tools.

Like atomic energy the use of computers will be welcomed and used more by industry and government than by individuals. Like atomic energy the public acceptance of computers will depend upon the most visible use to which computers are put. Many businesses already use computers extensively. They have already brought change to travel agencies, steel mills, insurance agencies, and plywood mills, to mention just a few. I am aware of the business use of computers. In this article, however, I am more concerned with the acceptance of computers in the school and home.

All of my students have an opportunity to use our classroom computer. Some parents want their child to learn to program it, some parents just want their child to use the computer for drill, other parents are afraid that computer use will keep their child from learning to think, and still others want their child to have no contact at all with computerized learning. These parents have already made up their minds about the computer: it is the wave of the future; it stifles creative thinking; it is the work of a malignant government, or of the devil.

In the nearby hills a dairy farmer has a computerized barn and refrigeration room where he can get constant readouts on milk production, butterfat content, temperature, and health information on each cow, or on the herd in general. The computer also directs the mixing of feed, the automatic fitting of milking machines, and it controls most of the milk processing equipment. The dairy man’s wife is not happy with the expense of the equipment, nor of the need for an auxiliary generator system to keep the system going during winter storms. Her kitchen still has a hand-pump in the sink for water, and she has to rely on kerosene when the storms keep lines down for weeks. The laborer, whose job was taken by the automated feed mixer, is probably not a fan of computers either, but he was unavailable for comment.

Much of the U.S. is still rural; most towns are still under 15,000 people. Few of those small towns have cable connections for commercial computer services, nor do many of the inhabitants have much use for computers outside of business hours (a pencil and back of an envelope is still the computer of choice for them). Most of the wage earners in smaller towns have no use for computers other than the ubiquitous TV game attachments.

Computers can threaten the status quo among even the well educated and upwardly mobile urban employees who do not want change, nor do they want to take the chance of being exposed as ignorant of modern methods. Employers, too, can be concerned about placing too much power in the hands of programmers and of electronic tools which they do not understand.
Until the current recession made labor unions aware of the problems concerning their own survival, many of them had task forces which were considering ways to discourage industry from using computers in any way that would replace a worker. At white collar levels there is resistance to bringing computers into business, not so much from fear of job replacement, as concern over changes in well-known office routine, or possible pressures for retraining.

In the shadows of those corporate towers are the inner cities where some people still are at a subsistence level of living. When you are constantly searching for food, clothing, or shelter you are not likely to be interested in computers. And there is no great interest in computers outside of the local electronic game arcade in the homes of what sociologists once called lower-middle-class citizens. There families watch reruns of Happy Days, work on their cars, play with their children, and worry about lay-offs. They are concerned about computers only when a monthly bill is in error, and they encounter difficulty in finding a human to correct the problem. The stupid computer which overcharges everyone is rapidly becoming a standard middle America folktale.

In a retirement community I recently visited I found that many of the residents would not go to a nearby Safeway Market because, “the computer” made a mistake when the clerk passed the same item over the sensor twice. These same people, prime consumers of medical care, would rather go to the old-fashioned doctor than to the clinic which uses computer assisted diagnosis. Among the elderly there is a very real distrust of computers.

Television documentaries and magazine articles about children and computers emphasize the fact that today’s children will soon be as familiar with computers as they now are with bicycles. It is difficult to get solid figures from school districts, but approximately 25% of all schools, nationwide, have at least one computer which students may use from time-to-time. Many of these computers are used primarily by the school district for record keeping. Out of the 52,000 computers of all sizes which are scattered among the nation’s 15,834 districts (U.S. Department of Education estimates) the majority of terminals are used for routine drill which requires no more knowledge of the machine than finding the alphabet, numbers and return key.

In visiting secondary schools I have seen teachers, usually math teachers, taking the fascination out of the computer with dry-as-dust lectures and routine practice which would discourage all but the most avid student. In a recent survey of middle and elementary schools I found only a few teachers willing to let their students use the computers for other than games and drills. Seldom were the students allowed to explore the real possibilities of computer use.

It is often argued that the students who use computers for multiplication drill, or to find square roots, or to play BAGLES are getting used to the computer. They are finding out that the computer is not some threatening robot but a helper in learning, a helper which can even be a toy. As the argument goes—should these students then want to go on to learn about programming and computer theory, they will be familiar with the terminal and external workings of the machine. I hope that this is true, but it sounds like one of those untested bits of conventional wisdom which comprise the bulk of educational practice.

Schools have always been able to take innovations in instruction and render them innocuous by institutionalizing them. Without a major change in the way computer skills are taught, there is little reason to expect the beginnings of a communication revolution in the public schools. Recent studies have shown that math teachers with computer training are leaving public schools for the better wages and working conditions of private industry. There also seem to be fewer and fewer competent math majors electing to become school teachers. Librarians, or media specialists, as they now seem to want to be called, are not leaving teaching by choice but are often early targets, especially at the elementary level, of budget-cutting administrators. The “back to basics” supporters are suspicious of any learning which is not of the paper and pencil variety, and so they are putting pressure on schools to downplay educational innovations, especially expensive innovations. Unimaginative school boards pay lip service to educating for the future but cut first time computer purchases and put limits on the expansion of existing programs. Students whose education ends at high school may never get the opportunity to find out if a computer would be of value to them in their lives after school.

For cultural, religious, economic, and a multitude of other reasons there will always be people who will not or cannot use computers in their homes. Many others who could use home computers will see no reason why they should. Their present record keeping is adequate, so why change? They get more news than they want over television, radio, or in newspapers, so why change? While resistance to change is often not logical, there is logic in not buying sophisticated equipment which requires training when a traditional and less expensive method for keeping records or retrieving information can be used. What the Third Wave types, in their urban apartments or suburban condos, do not realize is that not everyone is as fascinated by electronic communications as they are, nor do very many people conduct home-based businesses which make a home computer an economic necessity.

Those of us who want to encourage our students to learn to use computers for life-long learning, for profit, and for making life both easier and more interesting must be careful not to oversell our subject. Dreams are fine, but let us not turn them into fantasy. Let us keep them among ourselves lest we become unbelievable. We must always be aware of the possible future for computer use, but we must also realize what the probable future could be. I would not want to destroy any dreams but, in education, we must present dreams as practical realities, if we expect taxpayers to support them. That futurist book, which some student is now cherishing, will remain just a curiosity of literature if we attempt to promise too much too soon and never deliver our promise.
One measure of the contemporary computer revolution is the speed with which the machines are being introduced into the school curriculum. A few years ago only the best equipped technical schools would have had them. Now Bill Barber reports that he has already sat down first graders in front of a computer screen. Writing in a recent issue of Language Arts (May 1982; 59:5), Barber argues that keyboards and monitors are excellent ways to introduce young children to language in easy bites.

"The microcomputer is an indispensable feature in my classroom," he says, "more useful than ditto machines, copiers, or any other teaching machines." That is because with the computer Barber can quickly and easily record and compare the language productions of his students. For instance, their very first day in school he has each kid tell a story about himself. By the end of the school day the computer's printer has done its work. "The stories went home in back packs while a copy of each remained at school in brand new folders entitled, 'My Stories'."

In another exercise Barber typed into the computer typical sentences from each student's essay. Those went up on a large monitor screen for everybody to see and the children read each other's sentences and compared them. "The processes of editing and revising seemed to occur naturally as they read from the monitor," he reports. "They quickly noticed the difference between my standard spelling on the monitor and their own invented spellings."

By these means children quickly learn how to manipulate their own language for themselves. "Inserting, deleting, rearranging are all part of the process that students should go through as they develop control over written language—and that's what the microcomputer does best."

Finally, Barber, who is on the reading faculty at Fort Hays State University, notes that since there are a number of different machines on the market, a teacher needs to carefully determine which best suits the students' needs. "So shop around before making a decision," he advises.

CONSUMER REPORTS
To guide them on those shopping expeditions, special educators interested in adding computers to their programs should look at a comprehensive round-up on the subject in Learning (Jan. 1982). There David Grady and the journal's other editors have neatly arranged lists of: a) funding sources open to proposals for grants to equip schools with the machines; b) a bibliography of periodical literature listing publications which "either have a predominant classroom focus or frequently run articles about computers and education"; c) a basic (beginning with BASIC) lexicon of computer terminology, so that teachers and administrators can quickly plug into the lingo of those periodicals; d) a list of professional associations in which "educators, media professionals and data processors are getting together to exchange ideas, information, materials, expertise, and problems"; e) a list of sources for hardware and software catalogues; and f) a calendar of various meetings, forums, etc. showcasing computers and their applications to education.

NOTHING TO FEAR BUT FEAR ITSELF
Besides hard- and software, a computer equipped classroom also needs a teacher—one who is not intimidated by the machines' intrusion into her domain. Willis Morrissey has been working on just that problem in a course he teaches on "Computers In Instruction" at the College of Education, New Mexico State University. Reviewing his experiences in The Computing Teacher (8:2), Morrissey
also reports that he has used his method in one-day in-service workshops with local school district personnel. That method revolves around the following principles:

1) Demystify the hardware. To that end Morrissey stresses that the computer is a machine, not a brain. That last ingredient has to be supplied by the person using the micro. In fact, he puts his students through a series of exercises designed to show "how dumb a computer really is."

2) Conversely, demonstrate that the machine does not replace the teacher. "We emphasize, over and over again, that the classroom computer still requires a creative teacher," he says.

3) Confront the average person's fear that computers are only for "specialists." In order to do that, Morrissey takes pains to see that his students' first experiences with the machines are satisfactory ones. So he avoids programming at the beginning of his courses. "The frustrations encountered by the beginning programmer," he justly notes, "do nothing to help a neophyte's self-confidence."

4) Have each student demonstrate, to herself, exactly what the computer can do for her own classroom. Thus his courses finish with each student doing a term paper on state-of-the-art computer aided instruction in her own teaching field.

COMPUTER GAMES
War games can, of course, be nicely simulated on a microprocessor's screen. But Andrew Calkins says that computers can also bring a school building to the very brink of civil war. In a recent issue of Electronic Learning (March/April 1982), Calkins, an associate editor of that journal, observes that computers don't start those wars. But they can exacerbate existing political divisions within a school's faculty—dividing it into computer enthusiasts and their noncomputing colleagues, as well as spurring rivalries between teachers and departments for limited computer resources.

To put out these potential brush fires, Calkins offers the following peace keeping suggestions: a) Avoid the math department take over syndrome. It may seem logical to house the machines in math, but that's bound to stir resentments among other departments. So try, instead, to put the micros on neutral ground, in the library, or media center. b) Head off the bandwagon effect. Once the machines are in the door, many teachers feel under pressure to use them willy-nilly. Some take this bandwagon effect as a subtle attack upon their own teaching skills. So it is much better to make the micros entry a low-keyed affair. Don't force every faculty member to sign up for retraining. Let the natural enthusiasts do their thing, and slowly, but surely, by their example the word will get around about the machines' potential. c) Don't make it an administrators-vs-teachers game. Often an administrator will get gung-ho about micros only to find his own enthusiasm matched step-for-step by the faculty's resistance. To the latter, their boss' new commitment seems suspiciously like an old-fashioned work speed up. The solution? "If an administrator wants to avoid political confrontation later on," Calkins claims, "he or she might well do some 'soft sell' politicking in the very beginning." One of the best ways is to include teachers, as well as administrative staff, on the computer planning committee from the very beginning.

WHAT TO DO?
Okay, we've been converted. All our anxieties are under control, and we've guarded our school against micro-civil war. We're ready, willing, and able to introduce computers into our classroom. How do we decide what we want them to do for our students? That is the subject of an interesting review by Patrick H. McCann. Writing in a recent issue of the British journal Computers & Education (5:3; 1981), McCann observes that instructional programs are created by the programmer's technical skills. But they should be chosen in accordance with the teacher's educational philosophy. He notes that computer based instructional systems can be divided into two groups: those where the locus of control is inherent in the system itself, and those where the student takes control. Each has its advocates. Which is better? That is a philosophical rather than a technical issue, according to McCann. It's also one for which there probably is no hard and fast rule, as is so often the case in other areas of instructional choice. "Education progresses from kindergarten, where it is scarcely learner-controlled at all," he notes, "to graduate school where it is predominately learner controlled."

McCann also observes that while it has not yet been generally recognized in the literature, computer based instructional systems can be judged by their affective, as well as cognitive consequences. "An effective instructional system should lead to moderate or low levels of anxiety in addition to leading to mastery performance outcomes," he says. In similar fashion he also discusses such issues as: a) preinstructional strategies—should students be given pretests or advance overviews? What are the consequences of each when the student finally sits down to his instructional program? b) Evaluation techniques—is it better to build testing right into a learning program? Or should it be postponed until a student has worked his way through a certain amount of material? How do various types of tests affect the learner's progress? Are these effects the same or different for students of varying ability levels?

"Hardware development has grown astronomically over the past two decades, while our knowledge of how students learn has proceeded much slower," McCann concludes. That is certainly true. But with his essay as a guide even the beginning computer user can make some educated guesses about what kind of system will best match the needs and skills of her students.

QUO VADIS?
"There is little doubt that the 1980s will be a decade of learning," notes James Botkin. "The question is what type of learning the 1980s will bring." A faculty member at Harvard's Graduate School of Education, Botkin poses some answers in a recent issue of Prospects (12:1; 1982), UNESCO's quarterly review of education. But those very answers provoke some more questions of their own. For instance, Botkin observes that the computer revolution is not just an American phenomenon. France already has a program underway which will install 10,000 micro-processors in that nation's secondary schools.
Online

by 1985. Even more striking is the fact that a full third of all doctoral degrees in computer sciences at American universities are currently granted to foreign students, and the majority of those are from Third World nations.

Coupled with the revolution through which computer technology is presently passing, that last statistic has world-wide implications for education. Even a decade ago computers were massive machines demanding a high level of technical skill on the part of their users. Now they have been physically shrunk by the new micro-based technologies, and can be programmed with a minimum of expertise. The next generation of computers will be powered by small batteries, like those now used in transistor radios. “This relatively simple development,” Botkin forecasts, “would have special significance for many developing countries. It would allow microcomputers to be used in places that do not yet have access to public supplied electricity.” The microcomputer could become as widespread as the transistor radio, and that would revolutionize both education and Third World societies. Already many developing nations are adapting parts of western society’s school system. Microcomputers would only quicken the pace of that development.

Whether or not that is culturally or sociologically desirable is a question that has not yet been faced. Such an educational revolution would plug Third World societies into the high technology economies of North America, Western Europe, and Japan; it would also alienate them from their own cultural heritage. Unless, that is, some way can be found to link modern educational technology to the preservation of the best of nonwestern cultural traditions. So the critical question becomes: “As developing countries increase their experimentation with computers in education, will they tend to use software developed abroad, or will they initiate ways to have users themselves create the end-product programs? Further, will these user-created programs incorporate characteristics compatible with and supportive of indigenous culture, or is the nature of even the new technology such that it has embedded within it unalterable values of high technology societies?”

On the answer to those questions, Botkin thinks, turns the even larger one of how the future will look back upon the educational revolution of the 80s. From the perspective of our descendants, will microprocessors look like the final instrument in freeing mankind from poverty and want? Or will they be just another link in the chain by which his technology came, in the end, only to enslave man?

US AS WELL

But it’s not just the Third World that is ripe for such computer assisted cultural struggles. So warns Daniel Watt, who is involved with MIT’s logo project. Writing in Popular Computing (May 1982), Watt argues that the computer revolution could also exacerbate our own country’s social strains. “To say that computers can make a difference in the ways people learn is not to say that they will be used to do so,” he says. He notes that the computer revolution in education is currently proceeding at a very uneven pace. Public schools, where funds are tight, are sometimes less enthusiastic about micros than private schools. In inner-city schools microprocessors are more often used to help educationally disadvantaged kids upgrade basic skills. In a well-fixed suburban community those same machines enable kids to explore the cutting edge of contemporary science. Boys are more likely than girls to be enrolled in advanced computer courses.

Looking to the future, Watt foresees that if the schools don’t keep pace with the increasing computerization of our society and economy, then parents will begin to supplement their children’s computer experiences outside of the classroom. After school computer lessons might become rivals to music lessons. But, again, this development is not likely to be uniform. Better fixed parents will lead the way. All of which is likely to widen the gap between the haves and have nots. What’s the solution? According to Watt, it is to hold fast to the traditional premise of education in America: The schools should “provide all students with equal educational opportunities which translate into equal access to economic and social advancement.” To insure that, he concludes, parents, teachers, and school administrators must help develop a national consensus around the concept of computer literacy for all children.

FRINGE BENEFITS

The larger case for computer assisted instruction has often been made. But there are some fringe benefits to microprocessors which are less publicly celebrated. In a recent issue of Classroom Computer News (2:1), Gloria Stein reminds us of several of these. A sixth grade teacher in Ann Arbor, Michigan, Stein notes that the computer can be used for on-the-spot diagnosis of a child’s learning problems. That’s because most computer users think out loud. So, she argues, instead of sending a kid off to the school psychologist for extensive testing, first try sitting him down at a micro. Listen to his muttering while he manipulates the machine and you might just get a handle on his problems. For instance, the child says to himself “9 times 9 is 81,” and types it in. Immediately, his teacher realizes that she’s dealing with a reversal problem. In general, Stein says, “careful listening to thoughts will reveal individual roadblocks to learning.”

She also observes that children often play out their struggles with their parents in the classroom. The parent enjoins him to excel in school, and the child responds with passive resistance, refusing to engage himself in his assignments. Caught in the middle, the teacher often responds emotionally, which, of course, only stiffens the child’s resolve. The computer, however, is different in two respects. First, it’s engaging, and a toy that few kids can resist. Second, it’s neutral in this kind of tug of war, and thus can help lure a problem child out of his withdrawal. “The computer is far more passively resistant than the child,” she wryly notes. “If the child refuses to respond, so will the computer—with no emotion.” All the usual rewards the resistant child gets from adults’ response to his behavior—anger, frustration, etc.—are thus denied him, and he will often now give them up.