

FUTURE TENSE^{*}

by

Leonard Reiffel

Long ago, but in that peculiar way in which the years fool us all, not really very long ago at all, I was seven or eight years old and walked a few blocks to school each weekday morning, returning along those same few blocks each afternoon. In those days before television and microelectronic games and jet planes, the sidewalks were our gameboards, and we were careful not to step on the cracks so as not to break our mother's backs, and we lagged stones at the lines, and the girls (at least mostly the girls) chalked hopscotch patterns on the rough concrete, always choosing perfect sidewalk squares without the occasional asphalt patches in the corners or large jagged cracks that would mar the perfection of the chalklines. It was a time that people today seem fond of describing as simpler and slower. I'm not sure they are right in using such adjectives, but it was certainly a time when I was less concerned with the future and more bound up in present problems such as why I couldn't hit a softball quite as far as some of the other guys during those afternoon pick-up games in the street which we managed to organize and operate in the middle of St. Louis Avenue despite the occasional interruptions of passing automobiles.

Our softball ground rules were peculiarly suited to the times. If the ball ran under a parked car, it was an automatic double; no way anyone deserved a home run for that! The cars were a convenience as well as a hindrance. A fender could serve as first base and a door handle on the other side of the street could serve as third. Second base was usually a dimpled wrought iron cover of a manhole. Home plate was the base that was usually improvised most ingeniously because sewer covers weren't placed closely enough together so that two were available with the right separation between them. Somebody's clean shirt, a paper bag, or crushed tin cans all make pretty adequate home plates although, as a pitcher, I usually preferred shirts because they offered a bigger strike zone.

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I never was very good at street softball, but I could lag pennies (or pebbles when we had no pennies) with the best of them and, of course, staying off the cracks was easy, so my mother's back was really never in any danger.

It must have been at a still earlier time, probably when I was a carefully washed and combed young kindergarten gentleman, that somebody showed me a game which I always suspected was more a girl's game than a boy's but which, at least in our neighborhood, we all played until we wised up. There are many versions of the chant we mouthed in gleeful unison, not knowing why and not quite knowing why it was supposed to be fun to hold hands in a circle and march around so solemnly and then collapse onto the floor.

"Ring around the rosy,
Pocket full of posies, (I forget the third line)
All fall down."

Another version which my research tells me was played a little further north in the city went:

"Ring around the rosy,
Pocket full of posies,
Last one down,
Is a big fat clown."

More recently I came upon a third version which goes

"Ring a ring of rosy,
A pocketful of posies,
Achoo...Achoo...
All fall down!"

This last is the British or, more precisely, the London version of the same chant.

I wonder what's become of those little girls and boys. I wonder where they've all gone. We boys left those circles early. Somehow we knew that dancing in circles was not manly, at least not in America, and not in the 1930's. We withdrew to our tougher, rougher more challenging games, leaving the girls behind to hold hands with each other, chanting, dancing and falling down amid giggles and laughter at the end of the rhyme.

Our little group, in particular, graduated to quite venturesome ways to entertain ourselves. We were pirates and we were cops and robbers and, about once a week, we would go by the corner fruit stores to dare the wrath of the merchants and the police and life sentences in prison by pocketing—I can admit this now only because the Statute of Limitations has run out—a nice fat orange or, more often, a few potatoes.

Ah, those potatoes! They were the catalysts for long afternoon camping trips in the empty back lot behind the corner S & S Radio Store, on the corner of Drake Avenue and Irving Park. That was the place where adventures began. For reasons I cannot fathom from this time and distance but can still feel, it was wonderful to spend an afternoon after school amid the trash and abandoned oil drums. Find a properly shaped forked stick, or pull it off a nearby tree if you have to, sharpen it with your pocketknife, and carefully impale a raw potato. Now with papers and more wood, build a bonfire either in a ring of rocks or, if you want to do things up really right, in one of the empty old drums. Of course, you had to be careful not to get the fire too big and you had to worry about making holes at the bottom of the drum so that air could get in, but an empty drum seemed a dandy way to contain a fire and roast potatoes.

From time to time we would even dare to eat potatoes made in this remarkable way, but I do not have a clear recollection of doing so very often. There was, frankly, a largely unsolved technical problem with roasting potatoes. As I remember it, according to this prescription, no matter how carefully you held them near the flame, they always seemed to get quite black on the outside and remain rather hard and raw on the interior. It took us perhaps a year to advance the technology of cooking potatoes to the point of burying them in the hot coals which remained after the live flames had burned themselves out. That helped, although it was a far-from-perfect procedure. Such is the halting pace of progress.

By the time we were reasonably expert potato-roasters, the days of playing "Ring around a rosie" were long behind us, but I daresay we were still not much concerned about the future, at least any future which extended much

beyond that afternoon or that evening's homework or the next morning at school. Our futures lay all before us like tightly wound balls of twine from which just a little of the string had been pulled. There was nothing ominous about the future and what might come to be... Oh, of course, there was the matter of Jack Armstrong and what might happen during his continuing 5:00 p.m. radio adventures, but those worries we knew were not real worries and somehow everything would turn out all right.....

If not in terms of cosmic time, then at least on the scale of one human life, all of this was very long ago. Today, as I walk or ride through a neighborhood like the one in which I grew up, there are no baseball games in the street anymore or so it seems. At least I never find them. And the sidewalks, while heavily littered with trash, are not decorated with the chalk-marks of hopscotch games. And no one seems to roast potatoes in the empty lots anymore. The islands of the pirate Carribean are gone from behind the Radio Store. And no one even seems to draw crude circles in the bare earth and squat down to sight an aggie in the direction of a bunch of other mibs and smile triumphantly when (more luck than skill) a marble gets knocked out of the ring and is added to your pile.

Instead, the kids of the 1980's have television and those damned video games and those even more damnable suitcase-sized "Entertainment Centers" that seem to grow out of the sides of their heads. Well, so what? I'm not sure it matters as much as I'd like it to. My nostalgia for that backlot potato-roasting, I can overhear from time to time, has been replaced by nostalgia for the days of Bozo and Captain Kangaroo. Children are resilient creatures and despite the curse of drugs and other problems, I hope today's kids are as optimistic about what lies ahead—and as unconcerned with it—as we were in our days of innocence. There is time enough ahead for them to become tense about the future if they must.

Of course, for you and I, we who are so long away from Ring around the Rosy, the circumstances are quite different. The rules of life dictate that we must try to face today squarely and think, as best we can, about tomorrow. It is

no small assignment and the rules of the game are not as clear as those of street softball. No one plays the real Future Game very well.

To say the future is being shaped by enormous and ill-defined forces is to mouth the obvious. To take the next step—that is to try to isolate which of the great streams of change in which we are immersed may be most influential and filled with portent for the future—is like trying to choose between heavy waves on a stormy ocean. And to take the next step still, by asking questions about how these huge, heaving complexities will interact with each other, is to face tidal waves of uncertainty.

Nevertheless, and despite the daunting nature of these tasks, indeed despite the likelihood that any answers we give or procedures we use are likely to be wrong, it seems somehow absolutely necessary to try to think about the future.

But what aspects of the future are most important? Let me offer, as one place to start, an extremely restrictive criterion for selection which, even if entirely wrong, has the virtue of being rather interesting. I repeat my warning: The criterion will be restrictive and the resulting sorting process will be severe.

Scientists and engineers are fond of using the term "order of magnitude." The phrase refers to the approximate quantity of something or other—usually and more specifically, it means a measure to within a factor of ten. So the order of magnitude of something might be one or ten or 100 units. If one thing differs from another by a couple of orders of magnitude, a couple of orders of ten, that means it is about 100 times smaller, larger, or whatever. Three orders of magnitude would be three factors of ten, hence $10 \times 10 \times 10$ or a thousand-fold difference.

Suppose we look at the forces of change in terms of orders of magnitude. As a way of defining truly significant differences between capabilities—between yesterday and today, between today and tomorrow—order of magnitude might work well in some cases, but not at all in others. For example, a change of far less than a factor of ten in the average lifespan of the human being or in world population would imply monumental effects on every aspect of

society and existence. In certain scientific/technical areas, especially those in which I am most comfortable, the concept may not be quite so bad. Having given fair warning, let us consider for a moment some of the things that have changed by orders of magnitude since I played softball on the street. We will then choose one to project ahead a little into the future.

What has changed by several factors of ten or more? Certainly not our ability to prevent starvation; nor our ability to discover and use natural resources; nor our techniques for constructing shelter; our methods of moving across the ground have changed somewhat, but forty years ago autos were going 100 miles an hour and they aren't going a thousand miles an hour today.

Our methods of education are much as they were. Teachers are still fighting to keep the attention of unruly classes. The discipline problems are worse than they used to be, but one cannot say they are literally 100 times worse for a given type of student body.

Our methods of predicting and coping with the weather are better today than in the 1930's, but who would claim a factor of even ten-fold more precision or a factor of even two in our defenses against hurricanes and tornados?

Our food supplies and capabilities for farming are not different from the 1930's by orders of magnitude. Even that technological wonder—the jet aircraft—did not advance the frontiers of aviation performance by several factors of ten, rather more like a factor of two or three. A change like that is important but I would argue not sufficiently profound to fit the selection criterion.

Consider the way our order of magnitude criterion segments the whole technical history of transportation. At ten miles an hour, one is in the walking and horse and buggy world; at 100 miles an hour in the realm of the automobile; at 1,000 miles an hour in the kingdom of the jet aircraft. But between the propeller-driven airplane of Charles Lindberg and the trans-Atlantic jets of today, there is less than an order of magnitude in speed and less of a difference

in human experience than between plane and automobile.

Where, then, since my days of hopscotch and marbles and Ring Around the Rosy are differences in man's basic capabilities to be measured in terms of several orders of magnitude? If we can find those places and those elements, we might find some of the predominant driving forces behind this shared sense of sweeping change in all our lives. One can immediately isolate at least three candidates. There are surely many more.

The three I propose are these:

First, man's ability to release energy as represented by nuclear energy and fusion energy;

Second, our ability to distance ourselves or our artifacts from our home planet via rocket;

Third, our ability to create systems of information and their content—the gamut of things which include television, communication satellites, computers, microelectronics, and still newer technologies such as photonics.

In each of these arenas, man's power has expanded not just a mere ten or 100-fold but (incredibly) from 1,000 to a million-fold in a few short decades! The consequences are thundering toward us...or soon will be.

Despite the public relations hoopla, I do not consider that we have yet begun to feel the major effects of our new-born abilities to leave this earth and venture out a thousand or a million miles away. Aside from communication satellites and weather monitors which are really information systems, the average person has not been grossly affected by space exploration per se except in the sense of sharing momentary entertainments. How many of you can name the fifth astronaut on the moon? And in any sense related to ordinary life, what difference did the moon landings make? Nor have the scientifically interesting and technologically magnificent tours of the planets by unmanned spacecraft meant much to the people left behind on the earth by the roaming robots of space.

Some have argued that it is only after having seen the earth from a distance through the eyes of cameras carried by astronauts or by unmanned spacecraft that we came truly to appreciate earth's uniqueness in the solar system and in the cosmos. I think those pronouncements are somewhat fatuous. It would take a humanity of extraordinarily limited imagination to need pictures

from space to tell it that this good green-blue and white globe of ours was precious. The American Indians, among many others, knew that centuries before space photos. Such comments to me are self-serving public relations nonsense made by those with special interests in only one aspect—albeit a perfectly valid one—of scientific research.

Do not misunderstand, however. Most assuredly, I believe in the value of space exploration for all of us. I am certain that when we are as far removed into the future from this day as we are from past times when I was watching girls play hopscotch, the true significance of our abilities to reach out into space will be much more obvious. Space shuttle is perhaps the beginning of the wave of real impact of space upon everyone. There will come a time in the next twenty to forty years when people like us will be working in space; when factories and other facilities taking advantage of the unique vantage point and gravity-free conditions of that environment will be routinely manufacturing materials of commerce and offering services that are unheard of today. It will be those new materials and services along with deep new knowledge of the universe that will be felt as order of magnitude differences in our lives.

As concerns man's recent progress in energy release capabilities, little need be said on this occasion. Fine dinners and good company are not settings in which to dwell long upon either hydrogen bombs or nuclear power controversies. You know very well what the million-fold and more change in releaseable energy—the step from chemical fuels to nuclear fuels—has meant and could mean to life on earth. There is no retreat from having stepped across the nuclear threshold.

I, for one, hold to the guarded belief that we shall learn hard nuclear lessons but we will stop short of Armageddon. Nuclear power, in my view, is destined for continued and successful development, although not without still further frightening missteps. The supreme problem for mankind, as viewed from the distance of another fifty years or so, will not be nuclear power.

Rather, and for centuries beyond 2000 AD, it will continue to be the avoidance of global nuclear war. Our only choice is to achieve the wisdom to control our nuclear futures by controlling ourselves. And it is precisely here that the third great order-of-magnitude change which is occurring becomes poignantly relevant. It is one which leaps out at even the most casual observer.

The information systems man is coming to possess are literally exploding with changes spanning factors of millions or billions. These information systems could help humanity finally develop the mutual understanding and the deep wisdom that will control all the other major forces which are at work in the world.

Today every aspect of our ability to acquire, store, manipulate, transport, reproduce, and present information is undergoing a simultaneous expansion by many factors of ten.

Where just a few decades ago we had only clumsy still cameras and awkward sound recording devices to acquire audiovisual information, now, suddenly, new acquisition systems are everywhere.

Self-focusing cameras...cameras that develop their own film...holographic cameras that can capture three-dimensional information...TV cameras no larger than yesterday's simple box cameras.

Optical character readers can acquire information from the printed page, voice recognition equipment, from the human voice, touch- and position-sensitive devices, from the human hand.

Where once we had a few standard silver halide films, the phonograph, and the written word or drawing with which to store and retrieve information, we now have—or soon will have—a boggling profusion of audio-cassettes and records; many film formats; videotapes; digital discs; video discs; reusable video discs, discs capable of being photocopied; black and white and color microfiche; photochromic memories; semiconductor electronic memories; holographic memories; magnetic bubble memories; cryogenic memories operating at temperatures near absolute zero; and who knows how many more?

In information storage systems—the high technology vaults of our collective experiences and skills—the pace of progress is nothing short of breathtaking. More and more information is being packed into less and less space at ever-lower cost. On the way are mass-produced preprogrammed electronic memories, a cubic inch or so in size containing as much information as hundreds of records or audio cassettes. These preloaded memories will be sold in much the same way as today's record albums, books, or small computer programs.

Soon, all-digital storage systems—working hand in hand with computer processing and capable of stacking 50 or even 100 generations of undegraded imagery or sound together—will be producing and storing incredible feats of manipulation of audiovisual information.

The day may even come when we store audiovisual data in single molecules—perhaps approaching nature's own awesome achievements in information storage. Remember that all of the vast quantity of data required to create a human being is stored in and retrieved from a few microscopic strands of DNA. Such is the ultimate limit to which our information storage technologies now realistically aspire!

No one need be told of the importance of computers as information manipulators. But for all the power of today's computers, they are only a beginning. Today's microprocessors are destined to be replaced by tomorrow's picoprocessors—with a hundred or even a thousand times the computational power on a single microscopic chip.

Large-scale computers are growing in power and accessibility as well. They will become first a hundred, then a thousand, then ten thousand times more powerful than today's systems, while simultaneously forming networks of cooperating megamachines. And in each machine of such a future network may reside more information-manipulating power than existed in the entire world just a decade ago!

Our abilities to transport information are matching our new abilities to manipulate it, stride for stride. We are no longer filled with awe as earth

stations watch our skies and space satellites orbit overhead. Yet these systems together transport millions of messages, trillions of bits of data, and countless numbers of pictures every minute of every day to almost every place that people live, learn, work, or play.

But here, too, as everywhere in information technology, we are only at a beginning. At this very moment, conventional lines are evolving into glass fiber-optical laser links with hundreds of times the message-carrying capacity of copper wire. A new word is creeping into our language, a word for the fast-moving light quanta that are beginning to replace electrons as the most fundamental carriers of information: Photonics. You will be hearing it much more often in this decade and beyond.

Cable systems, microwave systems and communications satellites promise to continue multiplying in number, power, and complexity in the next ten years. Space shuttles and astronauts already stand poised to deliver whole information systems to orbit, assemble them in the lofty silence of space, and even retrieve them for repair.

Once shuttle operations become commonplace, gigantic orbiting communications centers may soon follow. Huge antenna farms and power systems could offer a bewildering variety of broad new global information highways, and a limitless opportunity for new forms of personal information, entertainment, and services. We will have come far indeed from the radio programs of Jack Armstrong.

Perhaps only in the area of information display systems is the pace of progress currently other than breathtaking. But even here new multi-image systems, high-resolution television, and flat screens will finally arrive—initially in modest sizes or in theatre settings, but ultimately in homes or businesses and in sizes large enough to cover whole walls like huge audio-visual windows on the universe.

Inescapably, all of these ways to process information will reach into our schools, our offices, our factories and our farms...and they will surely reshape our society as metal is reshaped by hammer and blowtorch.

In this new age, books will contain electronic circuits as well as print, and computers will be given away free with audiovisual software packages.

Libraries will be more responsive to individual needs, as they draw a massive electronic files shared with other archival facilities. Personal computers will become, in effect, power outlets for great information utilities, and we won't have to visit one physically to draw on its resources.

In this new age, personalized electronic units combining communications, complete operating data files, and computer work systems—the beating heart of an entire career—will be carried in a briefcase or slipped into a pocket or a purse.

Formal education will evolve toward home-based or business-based lifelong learning. Corporations using high technology will compete with public institutions for the education dollar. Traditional publishers will be challenged by electronic media producers selling tapes, discs, and programmed chips made by fast, low-cost techniques.

Language barriers will fall under the onslaught of automatic voice recognition and synthesis equipment.

Simulation, with ever-greater fidelity, will allow us to create the illusion of reality...any reality, anytime, anywhere. The ultimate in instructional resources—reality itself—will be in our hands and malleable.

The entertainment industries will offer a stupefying diversity of choice. Their messages will become more personal, more involving, more subtly persuasive than ever.

But inevitably, just as now, progress will be program-limited; paced by what is to be communicated rather than by the means to communicate it. All of these technical systems for educating, entertaining, training, and understanding ourselves will share a continuing, insatiable appetite for software. Feeding these giant systems will require new cadres of professionals using new program-creation techniques, which will themselves be dependent on faster and more sophisticated hardware.

Our view of the earth and its problems will be reshaped top to bottom by the demands and abilities of these new information technologies for all the obvious reasons, and for one more that seems truly remarkable to me: All of these technical developments are characterized by the unprecedented opportunities they provide for interconnecting systems with one another to produce even larger systems working together.

Ultimately, I would think, immensely powerful interconnected facilities and programs will allow almost anyone anywhere to draw on the collective results of billions of man-years of human intellectual effort. The cumulative effect of this phenomenon on all of us who will be tightly joined to these technologies and information systems by our eyes and our ears will finally over-reach anything we can even imagine today.

It is impossible to be confident in predicting the many-faceted ways in which these information systems will alter what we do and how we do it. But I suspect, for example, that in less than fifty years many children will no longer be walking or even riding to hulking old school buildings. Those opportunities to pitch pennies or play hopscotch on the way home that were a feature of my youth will never come again even if tomorrow's kids wanted them. I think, quite simply, the schools themselves—at least as we know them today—will disappear. There will be no need to assemble students in antediluvian piles of brick and mortar when businesses and homes are wired into the whole world.

In urban areas, single city blocks (or even individual large apartment buildings) may be equipped with "store-front" facilities that will offer opportunities for socialization while technology easily delivers the very best teachers in the very best personalized, interactive software. The facilities will electronically access curricular materials, library support, and special services of all types, including diagnostics. In each local facility, one or more persons may act as guides, helpers, organizers and supervisors, but these "live" staff members will not be responsible for instruction per se.

Similar small but globally connected facilities will probably be established in businesses for on-the-job training and, of course, for all kinds

and levels of education and training in suburban and rural communities as well.

Athletics and other such features of current formal education will be organized independently of education—perhaps along the lines of neighborhood, business, or town teams and events.

Before you reject this concept as "too mechanical" or "too coldly technological," reflect on your own experience, thus far limited, with the fastbreaking developments in information technology. Then imagine the potential of the orders of magnitude more powerful, extremely intelligent and responsive electronic systems that are about to descend upon us. Perhaps you should re-consider your rejection. You ~~simply~~ have not encountered a marvelously wise and helpful electronic friend or pet as yet, but your grandchildren almost certainly will. And they will be wiser than we as a result.

Please be assured that I am not confusing technological power in information systems or elsewhere with the knowledge to use those powers to prevent nuclear wars or other catastrophes. It takes both wisdom and technology to make this a better world. I know the difference. But I also know that we are being gifted with great tools and I have an abiding faith in man's ultimate ability to make good use of what he learns to do. In threats and dangers there are always opportunities....and man survives.

In that long ago time, when I played "Ring around the rosy," I did not know the origins of the rhyme which was so much fun and which caused all that happy laughter. The rhyme originated in London about 1665.

"Ring a ring of rosy,
A pocket full of posies,
Achoo, Achoo,
All fall down!"

We laughed to it but Londoners died to it. Rosy refers to the rosy rash of the Great Black Plague, ringed to signify the horrible dark eruptions of the body called tokens that were its unmistakeable sign. The posies were herbs and spices carried to sweeten the air and perhaps in hope of warding off death. Sneezing was a common symptom as death approached. The final line

to which we giggled so gayly was, in actuality, a re-enactment of death in a city which lost 100,000 souls out of a population of less than 500,000 in a few short months. Look around you and imagine a time when one in five of us were taken in a single awful summer.

Thanks to knowledge and technology, most deadly pandemic diseases have now been controlled or eliminated. There has been a many order-of-magnitude reduction in death rates from such causes in the three centuries since the middle 1600's. Three centuries from now, through knowledge and technology far greater than any we possess today, other threats and dangers will have been brought under control as well. And man will have adapted and children will be laughing.