
THE FUTURE ISN'T WHAT IT USED TO BE
SORRY: PILOTS AND MECHANICS ARE OUT OF STOCK

Until a century ago nobody was very interested in the future for the simple reason that, apart from natural catastrophes and wars, the future was going to be the same as the past. A man knew that the pattern of his life would be the same as his great grandfather's, as far back as anyone could remember.

Well, now we know differently. We know the future is going to be profoundly different from the present, just as the present is profoundly different from the past. So let me outline some possible technological futures here—without pretending to predict which will come to be. However, even a technological forecast is extremely difficult, because inventions are going to be made soon—or may already have been made—that can have an impact on society far greater than the most far-sighted, optimistic, or pessimistic prophet could ever imagine.

I have two other reservations to hedge my bets—two technical developments which make any discussion of the future meaningless. They're both going to happen, but nobody knows when. The first is contact with intelligent extraterrestrials. This may happen tomorrow. It may not happen for a thousand years. It will happen one day. The second is development of ultra-intelligent machines. This will probably happen by the year 2001. When either of these things happens, all bets are off.

The pace of technology is doubling every ten years; 2001 is really as far off as the 1890's. Now the 1890's are an interesting period, because around then the great domestic revolution was taking place which transformed our everyday way of life more than anything that had happened in all the past—and perhaps in some ways more than anything that has happened since. The elements of that revolution are piped water, indoor plumbing, gas cooking and heating, electric light, and the telephone. The only comparable technological advance in the 1,000 years before was the introduction of glass windows.

What might be some *equally* great future changes in the home?

Within a couple of decades we'll be able to buy a kind of home automat in which the month's meals will be delivered in a package weighing perhaps a hundred pounds for the average family. Food will arrive dehydrated, as the astronauts have it, and it will be reconstituted and cooked automatically when we dial the right number on the selector panel. Or else a sign will flash, saying, "Sorry, filet mignon is out of stock."

But even if it is in stock, it will never have been near a cow, because we've got to face the fact that natural meat production is inefficient. It takes about ten pounds of vegetable matter to make one pound of meat. That means that for every man who eats meat ten men have got to starve—a situation that is already occurring in much of the world.

Even though the future isn't what it used to be—nor is it what it's going to be—science fiction author Arthur C. Clarke gamely speculates on life in the year 2001.

Cows, sheep, and pigs are mobile processing factories with an efficiency of less than 10 percent. We can't continue to waste good agricultural land on them. Well, I happen to be a carnivore who hates vegetables, so I regard this situation with considerable dismay. Maybe we can continue natural meat production on marginal land that's of no use for anything else, but this will mean domesticating new animals—such as antelopes, tapirs, or hippos—to exploit it.

And, of course, there is the sea. On the sea we are still what we were everywhere on the land until 10,000 years ago—primitive hunters. We've got to develop the equivalent of agriculture on the sea. I've written one novel about whale ranching, which is rather an exciting and spectacular possibility. After all, whales are intelligent animals; they can be controlled and herded, I'm sure, more easily than one can herd cattle. A 50-ton cow producing half a ton of milk a day is certainly an interesting economic proposition.

But even so, in the long run, our main food production will come from inorganic, nonliving materials, or materials which are no longer living such as coal, oil, and limestone. There is already some interesting work going on in the intermediate field of microbiological engineering. This is the development of strains of bacteria that can process inedible materials—such as sawdust and wastes of various kinds—into food which we or our animals can eat. If this sounds singularly revolting, let me remind you that cheeses, wines, and spirits are all the products of microbiological engineering.

This sort of technique has been applied to petroleum products, and the first fairly large-scale pilot plants have been built to produce large quantities of high-grade protein from petroleum. It has been calculated that three percent of the world's oil production can provide all the protein the human race needs.

Another thing that is going to come inevitably is the autonomous, self-contained community—perhaps as small as a single household—which can produce all its own food, indefinitely. This is going to be a by-product of space research, because for long-duration journeys and bases on the moon and planets, we have got to develop a closed-cycle ecology in which all wastes are reprocessed and converted back to food.

Buckminster Fuller has pictured this autonomous home as having no roots; it needs no water pipes and no drains and—we hope—no power lines. (Sooner or later we're going to have to find a way of either storing or generating electricity easily without forests of wires.) This autonomous

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Let me give a couple of examples of unanticipated inventions, which may seem rather comic, but which do teach a valuable lesson.

About a hundred years ago, when news from the United States reached England that a Mr. Edison had invented an electric light, the British called a parliamentary commission at which expert witnesses assured the gas companies that nothing further would be heard of this impractical invention. One of the witnesses was the chief engineer of the post office. Somebody said to him, "What about this latest device these ingenious Yankees have invented, the telephone? Do you think this has any applications in England?" Whereupon the chief engineer of the post office, no less, replied, "No, sir. The Americans have need of the telephone, but we do not. We have plenty of messenger boys."

Now, this is what I call a "failure of imagination." He obviously failed to see in the telephone anything more than a substitute for messenger boys. He coudn't even imagine that the time was going to come when it would transform the patterns of business, of social life, in fact of almost all human affairs.

Another example I'm fond of is a little nearer our own time. When the first horseless carriages started junketing around in clouds of smoke, it was pointed out that even when the bugs had been got out of them and they could travel as far as 50 miles without breaking down, they would be of limited application for an absolutely fundamental reason: There were no roads outside the cities. Who could have dreamed that within a lifetime most of the United States would be road?

One other, perhaps apocryphal, story about the way in which one can underestimate the social impact of an invention is that of the scientific committee called to evaluate the newly invented printing press—whether they should put any money into it—and they turned it down, pointing out to Mr. Gutenberg that there was obviously no call for such a device because, after all, hardly anybody could read.

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home could be completely mobile; a large house could be picked up by one of today's large helicopters and taken anywhere.

A mobile, planet-wide culture of the type I envisage demands cheap, instantaneous, and universal communications. The telephone revolutionized life in the past, but that was nothing compared to the communications revolution that is coming as a result of solid-state devices and the communications satellite, which abolished the last obstacles of distance. The first commercial comsat, Earlybird, which is now five years old, carries 240 separate television channels. Intersat 4, which is due for launching next year, will carry more than 6,000. By the end of the century there will be enough communications capability in orbit for the whole human race to pair off and talk to each other. And we'll need this kind of capacity, because our computers are even more talkative than we are.

What are the consequences of the communications revolution? Within ten years the home will have a kind of communications console with a television screen, television camera, computer keyboard, microphone, and probably hard-copy readout. Through this anyone will be able to exchange visual and written information with anyone else.

The newspaper as we know it will be extinct. Just dial a channel, and there will be the front page of our local paper —if there is a local paper. We'll see all the headlines, decide which ones interest us, and have them blown up one at a time so we can read the news, editorials, sports, and so forth. But this is only the beginning, because not only our local news service, but every news service—the *Sydney Morning Herald,* the *London Times, Pravda, La Prensa*—will be equally accessible at the touch of a button.

Ultimately this device will be plugged in to a global electronic library, and scholarship will be revolutionized. Another generation, which will take this for granted, will be unable to imagine how we were able to function without this information grid.

In the last hundred years civilization has spread several different types of grids. The first were the water and gas grids, then the electricity grid, then the telephone grid. The most recent, and perhaps the most significant of all, is the television grid. These television cable systems will be connected to the communications satellite system, and all mankind will be involved in an electronic nervous system. Any book that's ever been printed, any information, will be available as fast as we can dial the 20- or 30-digit numbers to retrieve it.

Telephone service as we know it now will be replaced; there will be no such thing as a long-distance call, because there are no long distances in the world of communications satellites. This means that all phone calls will be billed at a flat rate, if indeed they're billed at all. I suspect that we will just hire this service by the month or the year.

The really great revolution caused by communications satellites will come when the direct broadcast satellites are launched. Today's satellites are very low powered; they can only be picked up by huge ground stations with antennas as big as football fields, which then send a signal into the local television network. But most of the world has got no local television network. The capability will soon exist of launching satellites that will be so powerful that they can be picked up by the ordinary, domestic receiver, with perhaps $100 worth of extra antenna equipment that can be aimed up at the satellite in the sky. This is going to be of immense importance to the developing countries, which have inadequate or practically zero communications.

The Indian government has signed a contract with NASA to launch such a satellite in about 1973. The satellite will be powerful enough so that the signals can be picked up in all the villages of India. Now, the Indian government has social problems which we can scarcely imagine. They have half a million villages and half a billion people scattered over a whole continent, and about 90 percent of those people are illiterate. The Indian government thinks the only way they may be able to solve their twin problems of population growth and improved educational techniques will be through the use of educational TV programs broadcast directly to the villages.

On the educational level there have been some interesting studies of direct-broadcast satellites. For example, it has been estimated that we can provide 12 channels of color television to every school in a country like Brazil or Mexico. (Latin American countries are particularly promising because there are only one or two languages to deal with.) The cost works out at about $1.00 per pupil per year. No other method of getting information is remotely comparable in cheapness. These communications satellites may drag the whole world out of the Stone Age.

As far as the political impact is concerned, remember that the modern United States was created by two inventions a hundred years ago. Before they existed, there could not be a United States. Afterwards, it was impossible not to have a United States. Those inventions were, of course, the railroad and the electric telegraph.

We are now seeing the same situation on a global scale, but up one turn of the spiral; instead of the railroad

and the telegraph it's the jet plane and the communications satellite. I think the parallel is exact, and I think the final consequences will be the same. I only hope that the intermediate period is not as bloody.

On the linguistic level too the direct broadcast satellite is going to have a profound impact. Obviously, if any one country were to establish a monopoly of direct broadcast satellites, the language of that country could become the language of all mankind. I can think of nothing of greater political and cultural importance.

Bucky Fuller, whom one always seems to be quoting, says that this is the first generation to be reared by three parents. All future generations are going to be reared by three parents, and I know which is going to be the most influential in some families—that little box in the corner. Future generations will learn their vocabularies from it; in many countries they're going to learn their main language from it.

One of the problems of the global communications system is going to be the time zone. The world of the future will be like living in a small town where at any one time a third of the people are asleep, but we won't know which third. There seem to be two possible practical alternatives. One is to abolish sleep; it's never been proved to be necessary. It may be a bad habit we picked up a billion or so years ago. Many animals don't sleep; deep-sea creatures don't sleep. We may be able to find chemical or electronic means at least to compress our sleep into an hour or so a day.

If that doesn't work, we may have to abolish time zones, and say that everywhere on earth it's the same time of day. But if we were to do it in this brutal, simple, straightforward way, some people would be unlucky—they'd have to get up at sunset, work all through the night, and go to bed during the daytime. So besides synchronizing our watches and forgetting about time zones, we'd also switch from solar time, which is 24 hours, to sidereal time, which is four minutes shorter. In the course of a year the sidereal clock goes right around the daylight cycle. If I get up at six o'clock now and the sun is just rising, six months from now when I get up at six o'clock, the sun will just be setting. So everybody all around the world has equal time in the sun.

Finally, perhaps the greatest impact of communications satellites will be on the structure of our lives. Many people will be able to do most of their work without leaving home —unless their wives insist. (This is how we're going to solve the traffic problem.) I can see the time when almost any skill can be made independent of distance. Face-to-face contact will be necessary really only for social occasions. This means, amongst other trivia, that the city is doomed.

The city was necessary because it was the only way that men could get together to exchange ideas and do business. The communications explosion will render this obsolete. The city is probably dying already for other causes, but when men everywhere can meet at the touch of a button far more cheaply and conveniently than they can find a cab in a Manhattan rainstorm, they're going to choose the easier way of life.

Now, small cities and large towns will be necessary for many reasons for industrial processes. There will also be university towns, even in the age of teaching machines and televised lectures. But the vast congregations that have blighted so much of this planet for the last two centuries will slowly fade away. Very slowly, I'm afraid, because bricks and walls have got such enormous inertia and represent such gigantic capital investments.

I've little doubt that there will be even larger cities in the year 2001 than there are today, but they'll be like the dinosaurs in their last stage of giantism. A century later they'll be only bones—unless, well, there's always a possibility that the population explosion cannot be controlled. In that case the whole world could become one seething city.

Although everybody who understands the problem now accepts the need for population control, there's been very little thought given to the ultimate level. But once we take charge of reproduction and control the population growth, we can aim for any absolute level of population.

What level should we aim at? Well, the world could support a much larger population than it does today and at a good standard of living, apart from the psychological overcrowding. But should it do so? In a world of instantaneous communication, where all men are neighbors, what's the point of a population of more than a few million? The answer to this depends on the individual's

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Here we have a fascinating flashback to the point in time where all this trouble started—the building of the tower of Babel. I like to recall a passage from Genesis XI because it's so appropriate to this whole subject and to space exploration generally: "And the Lord said, 'Behold they are one people and they have all one language, and this is only the beginning of what they will do. And nothing that they propose to do now will be impossible for them.' "

We are seeing the beginning of the establishment of several global authorities. One of them—the International Telecommunications Union—has been in existence for a hundred years, yet most people have never heard of it. But even countries like mainland China belong to it. Now we're seeing an extension of it with the formation of InTelSat, an organization of about 70 countries in the communications satellite network. ComSat is the American member. Soon we'll see the organization of a world meteorological system based on weather satellites. And we've already got the World Health Organization and UNESCO. What I think and hope will happen is that some of these bodies, probably InTelSat, will get more and more powerful, more and more international, with more and more people working for them—and suddenly, to their great surprise, they'll find they're running the world. Before anyone realizes it.

philosophical and religious outlook. Astronomer Fred Hoyle once remarked to me that the optimum population of the world should be about 100,000 because that's the maximum number of people you can possibly get to know in a lifetime. You may say this is a rather self-centered point of view, but it's an interesting one, and it's worth remembering too. Plato thought the ideal city should contain about 5,000 free men. However, Plato's city also contained several times that number of slaves.

His "democracy" couldn't have managed without them, nor can the world of the future, especially if, as I hope, its population is ultimately stabilized at a small fraction of today's figure. Most of them, of course, will be robots at all levels of sophistication from simple-minded things like today's washing machines up to much more sophisticated, intelligent robots—the home computer to run the household, baby-sit the children, teach the children, answer phone calls, do income tax returns. The central brain will be somewhere in the house like today's air-conditioning or furnace system, and a lot of little slave robots will run around, doing odd jobs and cleaning up.

However, why should we go to the trouble of building complex electronic robots when nature has already done 99 percent of the job for us? We have been using animals for a long time as extensions of our personalities and our bodies. A sheep dog at work is a revelation; the working elephant, ditto; more recently, the seeing-eye dog for the blind. They are quite remarkable examples of what can be done with existing animals and really primitive training techniques. If we tried, in a few decades we could develop an animal—perhaps based on the chimpanzee—with a tenfold improvement in intelligence, motivation, vocabulary, and—above all—disposition. When it comes on the labor market, the servant shortage will be over. The housewife of 2001 need no longer be envious of her great grandmother of 1901—until the animals start to form their own unions.

You may well object that the net result of all these developments will be to eliminate 99 percent of human activity and to leave our descendants faced with a future of boredom, where the main problem in life will be deciding which of the several thousand television channels to tune to. This is perfectly true if we look at humanity as it's constituted today. H. G. Wells once said that future history will be a race between education and catastrophe. I doubt if even Wells realized the educational standards that must ultimately be reached to cope with the problem of universal leisure. While, ironically, politicians are always talking about full employment, we're heading for the exact reverse—full unemployment.

Just as there is no function today for manual laborers, there will be none tomorrow for those of only clerical or executive skills. The day after tomorrow society will have no place for anyone who is as ignorant as the average, mid-twentieth-century college graduate, who will be as lost and helpless then as a Pilgrim father would be if he were dumped suddenly in Times Square during the rush hour.

The greatest single industry of the future is education. The second greatest industry will be entertainment. And the two, despite the beliefs of some educators, are not necessarily incompatible. For every man education will have to be a process that continues all his life. We've got to abandon the idea that schooling is something restricted to youth. How can it be in a world where half the things a man knows at 20 are no longer true at 40, and half the things he knows at 40 hadn't been discovered when he was 20? The main social problem of the future is going to be that of raising the school-leaving age to approximately 120.

In the race against catastrophe of which Wells warned us, the last lap has already begun. If we lose it, the world of 2001 will be much like ours with its problems and evils and vices enlarged—perhaps beyond endurance. But if we win, 2001 could mark the great divide between barbarism and civilization. It is inspiring to realize that with some luck and much hard work, many of us have a chance of living to see the final end of the Dark Ages.