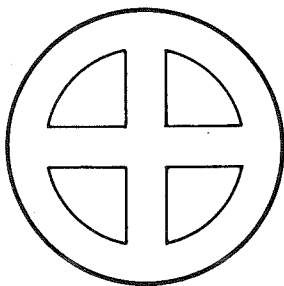


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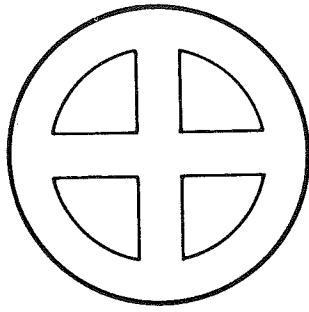
"Probing the Future: Exploring the Great Evolutionary Steps"

John Platt



Lutheran Brotherhood
Colloquium on the Church
in Future Society

The Woodlands Inn, Houston Texas • January 29 - February 2, 1979



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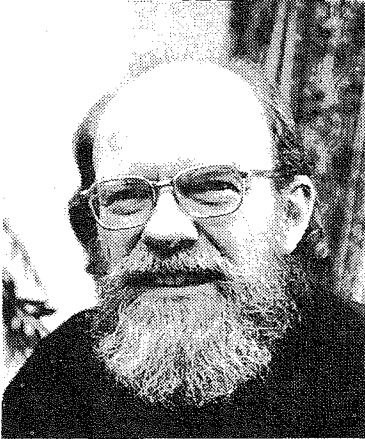
The Lutheran Brotherhood Colloquium on the Church in Future Society was a conference of 250 Lutheran leaders and ten nationally-known futurists. It was the first such event ever held by Lutheran Brotherhood, a fraternal benefit society serving Lutherans nationally, and was the result of consultations with several U.S. Lutheran church bodies. Among the concerns which were expressed by the church bodies in these consultations was the need for more disciplined emphasis on anticipated future changes as they influence congregational life.

The purpose of the Colloquium was to increase awareness of anticipated future change so that appropriate planning can be effected to strengthen the Lutheran church, especially at the congregational level.

All U.S. Lutheran church bodies were invited to take part in the planning, and nine participated by sending representatives, including six national presidents. Ten Lutheran church bodies were represented among the participants in the Colloquium.

The Colloquium was organized around five themes:

	Theme	Presentors
Monday	The Reality of Change	Alvin Toffler
Tuesday	Problems of the Future	John Platt Theodore Gordon Jürgen Moltmann
Wednesday	Human Values & Potential	Willis Harman Jean Houston
Thursday	Defining the Task	Warren Bennis Hazel Henderson Robert Jungk
Friday	The Role of Leadership	Harlan Cleveland



John Platt

Professor, Departments of Anthropology and Environmental Studies, University of California, Santa Barbara; formerly Associate Director, Mental Health Research Institute, University of Michigan.

Dr. Platt, former physicist, has worked for several years on general systems theory as applied to the problems of science and society and contemporary social changes. He is a consultant, lecturer and author on the interaction between science and society and urgent research needs for survival. As a humanistic scientist, he argues that the world needs a new structure of philosophical and religious belief if mankind is to survive in the coming decades. In an article regarding changes in belief systems, Dr. Platt states: "We are passing through a philosophical and religious transformation...consistent with our new scientific knowledge as well as with our new awareness of inner human meaning and outer global responsibility." He addresses eight evolutionary steps through which humankind is passing. We may now be experiencing the greatest of all these steps; he writes, "This metamorphosis to a new society, affecting not only ourselves but the whole ecology of the planet, is the greatest and most sudden jump in the whole history of evolution. It is a more dramatic change than the coming ashore of the land animals or the invention of speech. Yet perhaps such a culmination was implicit in evolution all along, as sure as the butterfly is implicit in the caterpillar."

He held a Guggenheim Fellowship at the University of London, received a U.S. Public Health Service Career Award, was a Fellow at the Center for Advanced Study in the Behavioral Sciences at Stanford, and received an honorary degree in psychology from Utah State University. He is a Fellow of the American Academy of Arts and Sciences, a member of the Club of Rome, and in 1976 was a Regents' Lecturer at the University of California at Santa Barbara where he is currently a professor of anthropology and environmental studies.

He has published numerous papers and two books on the structure and spectra of organic molecules and on the biophysics of vision and perception. Dr. Platt organized the widely-heralded Monday Lectures at the University of Chicago and edited the first collection of those entitled *New Views of the Nature of Man*. In addition, he has published many articles and books on the scientific creation and the world transformation today toward the evolutionary future. He has published articles in *Harper's*, *Horizon*, *Saturday Review*, *The New Republic*, *Main Currents in Modern Thought*, *The Center Magazine*, *Science*, *Futures* and *The Futurist*. His books include: *The Excitement of Science*; *The Step to Man*; *Perception and Change: Projections for Survival*; *On Social Transformation* (in preparation).

Dr. John Platt: "Probing the Future: Exploring the Great Evolutionary Steps"

Professor, Departments of Anthropology and Environmental Studies, University of California, Santa Barbara

Delivered on January 30, 1979 at the Lutheran Brotherhood Colloquium on the Church in Future Society.

I want to talk to you about the great world transformation through which we are passing. I think the best way to start is by emphasizing the enormous speed and scale of the technical changes of the last 30 years. In communications, for example, we now can talk by sight and sound around the world with the speed of light. If you compare this speed with that of about a hundred years ago, with the speed of horses, or the speed of ships, or even the speed of the first locomotive, the difference is a factor of approximately 10^7 , or 10 million times.

In travel, many of us have travelled at very nearly the speed of sound on jet planes that simply did not exist before about 1940. It is a jump from the speed of horses by about a factor of 100; and if you go on to the speed of the Concorde, or on up to speeds in orbit of 17,000 miles per hour, the speed is a hundred to a thousand times greater than 100 years ago.

In weapons, we have gone from the 20-ton blockbusters of 1944 to the 20-thousand-ton nuclear bombs of Hiroshima in 1945; then in 1953, to 20-million-ton hydrogen bombs. It's a factor of 10^6 -- one million times in a mere 10-year period.

In data processing, when I was a student at Northwestern, there was a thing called the Depression and they paid us students 50¢ an hour to do scut work for the library or physics department. They put me to computing for the physics department and I had a desk computer; and when I needed to multiply something by 47, I would multiply "one-two-three-four" and then I would flip the column, "one-two-three-four-five-six-seven." That year, 1935, we got our first electric desk computer and it had little motors to do what I had been doing. It was a Friden from Sweden. It turned out that it wasn't any faster than I was, but I wasn't as tired at the end of the day. Since that time, there have been something like five "generations" of electronic computers -- transistorized, microminiaturized and so on. They are up by at least a factor of 10^6 , maybe 10^9 -- a million to a billion times -- in speeds and capacities, from the times before.

Since that time there have been other developments that you can't put numbers on. There have been developments in exploration; people have gone to the top of the highest mountains, and to the bottom of the deepest oceans, just since 1953. And to the moon, how do you put numbers on that? Twelve men have now walked on the moon!

In the biological field, we now have effects around the world, such as the invention of oral contraceptives, the "green revolution," and the penicillin bacteria which are multiplying in the flasks. It is now human beings who are determining the numbers and the densities of all the plants and animals around the world. Before, we used to be a small perturbation on the great fluctuations of nature. Now we become one of the dominant fluctuations ourselves. The Bible said men were given dominion over the beasts of the field and the fowls of the air and the fish in the sea. Well, it was kind of a paper dominion there for a long while. The lions could still get you, and the rats could still out-multiply; but today, we begin to have the real dominion in the sense that we are responsible for this planet, this Garden of Eden. And if we mess it up, it stays messed up for a long time, and it won't be able to come back. One the other hand, if we treat it as stewards, as guardians and protectors of all these different forms of life and this "seamless web" of nature, then we can perhaps go on in balance with our ecology and in balance with our environment for a long time to come.

I am fond of saying that the year 1945 was a kind of crucial year when many of these things happened. That doesn't mean that these curves started exactly in 1945. One of these so-called "exponential" curves of growth doesn't "start" anywhere. You can go back hundreds of years, and it just enlarges the scale -- and you find people were saying, "Gee, things are changing fast in our generation!" You can go back to the Greeks, or maybe to when speech came in, or when fire came in -- and people were nudging each other and saying, "Boy, things have changed fast in this generation!" Nevertheless, about 1945, those exponential curves, those "logarithmic plots" took a sudden upward jump, by not merely a factor-of-two or a factor-of-five as in previous generations, but by these "orders of magnitude," suddenly within something like a 20- or 30-year period. The reason they jumped so enormously was because, for the first time, the human race had put its best physicists, chemists and biologists in the whole world to thinking about how to do new things. The great research and development teams of World War II brought in the atom bomb, the jet plane, and the electronic computer and all those other developments.

The result was that things happened with a jump or a lurch, about 1945, and most of these developments were within one or two years of that date. Sometimes I've called 1945 "World Year Zero" -- as though we might be starting a new era, a new epoch for the human race, dating it from this kind of technological date rather than from the religious dates that have characterized our societies in the past. As you will see, I think it is also a religious date, but we'll come to that later. Of course, if 1945 is World Year Zero, 1979 is World Year 034. Sometimes when I give this talk, people afterwards say that that zero in front of the "34" is the most hopeful thing in the whole talk. It is like an automobile odometer that measures your miles, and "034" implies that some day that "zero" might change to a "one." So it represents a faith that I have, that we can survive with these new powers for at least 100 years.

One of the interesting things about these new technological powers is that in many cases they are leveling off, or have leveled off already. Once you can communicate at the speed of light, that's it: you're not going to go any faster, at least in terms of any of the physics that any of us know today.

Similarly, once you can travel so fast that you are traveling around the Earth in orbit, as half a dozen people have been doing in this last year in one of the Russian orbiting laboratories, that's the fastest you can go over the surface of the Earth. If you go any faster than that you would leave the Earth and go out into the solar system.

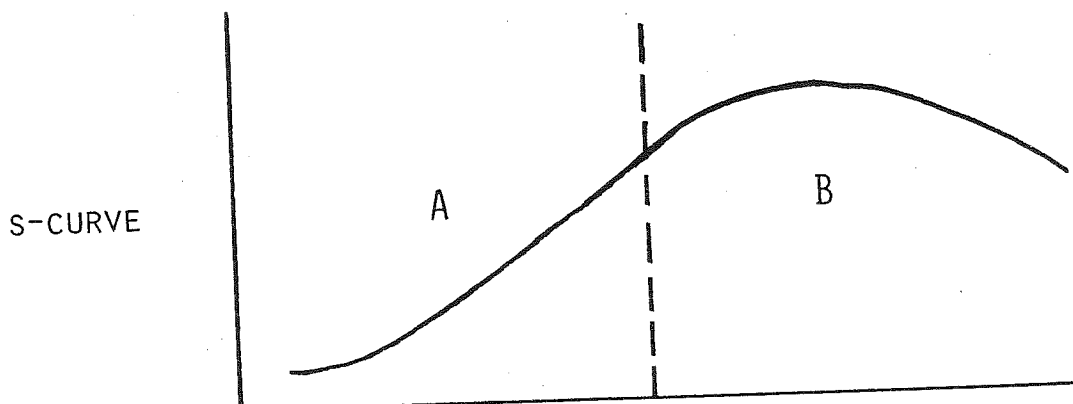
Likewise, in weapons, you can't be deader than dead. We already have so many megaton weapons in the U.S. and in the Russian arsenals -- something like 100,000 megatons. Some people have said that they can wipe out a large fraction of the life on earth if not all life on earth, perhaps back down to the cockroaches. (Cockroaches have a lot of radiation resistance. They have perhaps 100 times the radiation resistance that we have; so if we all got wiped out -- the higher mammals and the birds and the fish -- back to the cockroaches, maybe in 600 million years we'd be back up again where we could start over and do it all over. I think that's not quite the direction I want to go, but there is that possibility.) The danger today is not in the increasing size of weapons. If we increased a million times more the size of weapons, it would not increase our danger. The danger is in the lack of social and political control over these weapons, that is, in the lack of peace-keeping arrangements which will keep these weapons from being used, rather than in the size of the weapons themselves.

I don't want to overdo this statement that we are approaching some fundamental limits. In data processing, for instance, there may be remarkable things still to be done. And in exploration, the rest of the solar system still lies ahead. But in biological responsibility for the earth, we are responsible already. We are at a limit, like new adults who have learned to drive the car: we are now responsible, and this is now a permanent condition that will not be reversed.

So at least in some of these aspects we are leveling off -- in our structural relationships, our relationships of communications, of travel, and of human interaction. We are somewhat like a boy who stops growing, finally. Thank goodness! If I had gone on growing at the rate I was when I was 16, at age 60 I would be monstrous. I would not be able to pick myself up when I fell. The pattern of organic life is to grow structurally for a time, until one reaches maturity. And then you level off that structural growth so you can begin to grow inside, so that you can begin to manage these powers with confidence, instead of a stumbling teenager-adolescence. You level off so that you can grow in creativity and understanding in human relations, rather than in size.

I think in many of these directions the human race is leveling off because we are reaching maturity. These new characteristics may go on being fairly constant for hundreds or thousands of years to come. It's like when horses were first domesticated. They gave a big jump in speed for the military, for nomads, and for carrying messages, but then that speed remained constant for thousands of years. So we have these big jumps today in global interactions, in methods of social organization. If we learn how to manage these, we may be making social institutions which will last for a long time to come. But if we don't learn to manage them, obviously we'll wipe ourselves out. What we have therefore is one big jump suddenly which then levels off but which demands new forms of social organization in order to manage it.

It's rather interesting, I think, to see some of the social consequences of these technological changes of the last 30 years. Jonas Salk has a book called The Survival of the Wisest. (I thought for a time that he was referring to himself, but I decided afterward that maybe he was referring to all of us.) In that book he compares some of these so-called S-curves of change -- in which you have rapid growth and then leveling off -- to the curves of growth of bacteria in a flask. The bacteria grow. They double every 20 minutes if they have light and food dripping



in, so after 20 minutes there's twice as many, and after 40 minutes there's four times as many, after 60 minutes there's eight times as many. He calls this growth phase the "A" section of the curve. This is the section with "positive feedback." But then as the bacteria begin to approach the limits of the flask, the curve of growth levels off. He calls this the "B" section of the curve, the section with "negative feedback." The more they grow, the more they're inhibited. And so the numbers may level off or they may wipe themselves out by their poisons, or by exhausting all their food, or they may come to some sort of equilibrium with the sunlight or the food dripping into the flask.

But Salk emphasizes that in every case of this kind, there is a "point of inflection" -- a "watershed," in the old sense of the word watershed between section A and section B. It's like taking your foot off the gas and putting it on the brakes. And what he emphasizes is, that this watershed is a watershed not merely in technical numbers -- whether the bauxite is increasing by 8% or 13% -- but a watershed in human affairs, in ethics, in attitudes, and in laws.

For instance, Salk gives the example of population growth. The first part of the curve of growth (the A section) is the early part of population growth for the human race. This is when the human race has very low densities. God told Adam in the first chapter of Genesis, "Go forth. Be fruitful and multiply." And then about six chapters later he tells almost the same thing to Noah. And you see that you have to multiply in that situation; this is the only way to survive if you have only two of every species coming out of the ark. They've got to spread out and multiply because of natural hazards, because of the hostile famines and dangers and wars; and only by multiplying can they survive. But now, when you begin to reach the limits of the flask, you have to begin to think about a different ethics, about two children or one child (or none, at least for a time) -- about zero population growth. And that's the reason for the

emphasis today on smaller families in this country, and increasingly, in most of the countries around the world. It is not that there is any difference today in our large, overall goals, which might be something like "maximizing the potential of the human race." It is just that our tactics now must change, because the external reality has changed. In the A section of the curve, one maximizes the potential of the race by maximizing the number of human beings. In the B section, maximizing the number of human beings may very well wipe you out and destroy your potential. So now what you have to do is to level off the number of human beings and maximize the potentials inside -- the potentials of internal intellectual growth, the potentials of human understanding.

This situation explains some of the problems that many of our more traditional religious leaders are having today. They want to continue using the old ethical rules, which applied to a different external situation, without realizing that their larger goals will be damaged if they go on as before in the new situation. This is one of the reasons that so many communicants are leaving the Roman Catholic church today. You may have read the article in The New York Times a little while ago which quoted the National Opinion Research Center on the changes in the Roman Catholic church between 1970 and 1976. The loss of attendance in the United States was something like 50% according to the NORC study, which was conducted by Father Andrew Greeley, who is as you know a very independent priest but one much interested in the health of the church. This drop of about 50% was shown by attendance at confession, shown by purchase of diocesan journals, and shown by attendance at parochial schools; and of course it had many reasons, including economic reasons as well as others. Nevertheless, when Greeley and his group asked these former Catholics why they had left the church, 80% said it was because of disagreement with the Pope's encyclical on birth control. Catholics are practicing birth control about as much as Protestants and Jews, and their rates of contraception, abortion, and divorce are almost the same. These changes in all our attitudes and behavior in sexual and family matters are the results of these new technological developments, such as contraception, and intellectual work for women, and a mobile, affluent society which permits equality for women, as well as our realization of the danger of overpopulation. The result is that many former Catholics are seeing their own position as a moral position, and the church's position as an immoral position in our society today.

This critique of the old religions by people who are leaving them on moral grounds is a most interesting situation. It is said that something like 15,000 nuns and priests have left the Roman Catholic church, and it has become very hard to staff the priesthood in this country because of this defection. It is a form of protest against hierarchy, against the official attitudes towards women, against attitudes on birth and population, or attitudes towards Jews and outsiders, or towards the human needs of the poor in many countries, many of which these concerned nuns and priests began to feel were immoral attitudes. The result is that we are probably seeing the biggest change in the Roman Catholic church since the Protestant Reformation of 400 years ago; and it is driven by very much the same sort of feeling against what is seen as an immorality in the church itself.

You can see that I have gone into all this detail for the Roman Catholic church because it may be safe, at a Lutheran conference, and also because the statistics are the best in this case. But I am sure you are keenly aware of the similar pressures within your church and within the other Protestant churches for change and adaptation to these new phenomena of a new ethics for this new world of the last 30 years.

Salk goes on in his book with some other examples of a necessary reversal of ethics and attitudes today. He mentions economic growth and the growth of power consumption or the growth of consumption of nonrenewable resources. It is good to have more power consumption in every generation when you're down in this first part of the curve (the A section). It's good to have more resources turned into consumer goods. It gets rid of slavery and gives you machines instead; it gives you leisure, it gives you alternatives for personal development, more time for symphony orchestras, more books, more college education. But if you go on in that way when you begin to reach the limits of the flask, then your power consumption overheats the great cities. Los Angeles is 7 degrees above the temperature of Orange County. If it had gone on at the rate it was going a few years ago, by the year 2000 it would be 25 degrees above Orange County. Nobody is going to live there under those circumstances. They will all move out. It's a semi-desert already. So the result is that we are forced to realize that in the great cities we must begin to limit automobiles, new factories, new additions to the blacktop streets, or the size of the air conditioners, and so on and on -- because we are reaching the limits of the flask. The same thing is true in the consumption of nonrenewable resources. We have to begin to think about leaving a few of them for our children and

grandchildren. It's true that technology may some day, at a time unknown, by a method unknown, create new resources. And when it does, then we can open up our perspectives. But until it does, we'd be very foolish to use up all these resources which our grandchildren will need to create a decent society.

It's worth listing a number of similar changes of our attitudes, laws and ethics in just the last 10 years or so. They are the result of the impact of these new technological changes on society, say about 20 years down the road. Since about 1968 or so I think one can identify a dozen or more major changes in our laws, attitudes and ethics which I call "watershed" reversals. And they are a kind of sign that the responsive and responsible adults of the western world are now aware and concerned about the limits of the flask.

One change is in detente, for example. My mother used to say one should give the devil his due, so I think one should give Mr. Nixon his due: he did indeed -- in what was supposed to be a conservative administration -- open up the doors to China and Russia and put an end to what we called the Cold War. This was a recognition in 1969 that we are now in one world of terror, all in the same limited flask of nuclear missiles and weapons.

A second change is our development of an international money, the so-called "special drawing rights" as SDRs. They were proposed as a wild idea in 1964, but they were adopted in 1969. It's an example I think of some of that money Mr. Toffler was talking about yesterday, which is out of control. But it's also an example of watershed of another sort. It is the first time in human history that a group of nations has created a currency which is neither a national currency like the dollar nor a primitive currency like gold. It's a recognition that we're in one flask economically.

Likewise for our changes in ecology. The blocking of the American supersonic transport, the SST, in 1970 was a dramatic case. It was a watershed, because it was the first time in human history that a billion-dollar juggernaut of research and development, ready to make this great new machine in this country, was stopped in advance, on grounds of environmental or human concern. Even if we go on and make some SSTs later, or other countries make them, this moment of refusal represents a change in our perception. And of course the environmental concern today extends to hundreds of marshlands and expansions of cities and so on, to thousands of steps of environmental protection that we've taken just in the last ten years or so.

Another watershed is our changes in sex laws, on abortion, on contraception, on pornography, and on homosexuality. Whether you agree with them or not, whether they are wise or not, they are surely in a large measure the result of the new contraceptives which came in after World War II, as well as some of these other changes I've mentioned. They represent a watershed because it's the first time in western Christian history that sex acts between consenting adults have been legal. One has to go back to the Romans or the Greeks for that kind of legal policy. Even though there have been some very free sexual mores among the ruling classes in other countries, very frequently they have not been officially legal. Our changes today represent a kind of recognition by our legislators -- a recognition by the majority of people that they think they are speaking for -- that we are in a new world in terms of individual freedom and independence and in terms of refusing to obey the dictates of some central organization. It is a form of decentralized decision-making of the sort again that Mr. Toffler was talking about yesterday.

Associated with these changes in sexual practices is the recent drop in birth rates. Since 1971 the United States has been below replacement level in birth rates. Worldwatch Organization says that something like 30% of the human race now lives in countries where the birth rates are below replacement levels. This includes Catholic countries and Communist countries, as well as capitalist countries. It is interesting that it was not done by the sort of government measures that many "liberals" proposed only 10 years ago, because they were desperate. They thought we'd have to put contraceptives in the water supply, or have to sterilize everybody who had two children, or have to impose a tax on children. It turns out when you use these Fascist methods that people revolt; and a part of the reason for the overturn in Indira Gandhi's government in India was because of compulsory sterilization. But if you make the changes by voluntary methods as in this country, one gets a massive effect in a very short time. Tens of millions of couples have chosen to have fewer children, or to space them further apart, without dictation from Washington, in just the last 10 years. This is the reason for this worldwide drop in birth rates; there is a new consciousness of personal responsibility and of the limits to the flask.

To go on with other recent watersheds, our legal changes, including some I have already mentioned, are the greatest in this century. They include changes in the rights of prisoners, no-fault divorce, no-fault auto insurance, and the addition of drunkenness as a crime, in many

states. The universities have been transformed since 1968. The students now are adults; there is the 18-year-old vote, the end of military recruiting on campus, open dormitories, the end of the landlord contracts where students had to pay 12 months for 8 months' rent, students on boards of trustees, the hiring of women and minorities, the introduction of environmental courses. The students are now equal participants in the educational process instead of being treated as children, instead of the university being in loco parentis -- in the place of the parents -- as it was until 1970.

Behind many of these changes is our change in attitudes towards "limits to growth." The book by that title came out in 1972, and of course the idea was emphasized by the oil prices, but now all over the world we have a recognition that there are limits to growth, that growth per se is not necessarily desirable, that what we need is improvement in the quality of life, not in continued structural increase, not in growing monstrous like that 16-year-old who goes on growing the rest of his life. And this concept of limits is now found all the way from Petaluma, California, which won the right to exclude developers from extending the city, to St. Petersburg, Florida, where a short time ago the city council voted to send back north the last 25,000 new residents and to buy them jet tickets. It's politically absurd, of course; it was laughed down the next day by the city council again. But nevertheless that fact that Florida can think that, even for a day, shows that we have a new attitude towards growth we didn't have 10 years ago.

And finally our attitude toward the future is totally different from what it was 10 years ago. This is partly the result of Mr. Toffler's book, and partly the result of books like Herman Kahn's, or the Daedalus study on the year 2000. They tried to extrapolate 30 years forward, back in 1967 or so. It blew our minds! Nobody had tried to do that seriously since the Old Testament prophets -- and with computers too! It couldn't have been done on a serious technical basis in 1900 or 1910. We didn't have the knowledge. We didn't know about the world's water supply or what the population was. It couldn't have been done in the 1930s. There was Hitler to fight; it was all too likely that within 30 years we'd have the thousand-year Reich. It begins to be possible in this last 10 years to have the statistics to know where the globe is going, and to begin to have a common purpose of many, many nations to try to live into the year 2000.

Many of the predictions of those 1967 studies are now absurd, of course. Future studies are not yet a science, as you can tell. I doubt that any of us could have done any

better at that time, but those forecasts didn't have in them anything about pollution, about our environment, about smaller cars, about the oil crisis, about energy limitations, about the necessity for studying solar energy, about mass transit, about women's liberation and the changes in the structure of the work force and the family, and so on and on. It was totally unexpected. Here within 10 years we've undergone changes in attitudes far beyond what was predicted for the next 30 years in those books from 1967, and we have already reversed many of the things that they expected to happen. Nevertheless, we now have a belief in the future. We now have, I hope, corrected those first predictions, although we may have to go on correcting again and again.

Predicting the future is an ongoing study. It's like driving a bus. The fact that you have predicted a beautiful road ahead, and then you see a pothole, doesn't mean that you should stop looking or predicting. It means that you should look more sharply and look more accurately, and remember now when the fog is ahead that there may be potholes. So we need to go on in a kind of cybernetic way, steering our society toward the future in a way we never have before, and keeping an even better lookout, in spite of the mistakes we've made in the past. One of our most important changes today is that we now are spending tens of billions of dollars on research and development on things that will not happen until after the year 2000. It is the longest-range commitment to the future the western world has made. This includes things like solar energy, like fusion power, like mass transit, like less polluting cars, like food supplies for the year 2000, like space satellites which might broadcast solar energy down to earth. We have a belief in the future, which is one of the most hopeful things in the world today -- a common belief all over the world.

But now I want to draw back even further from these immediate changes today. I want to put these things not in the perspective of 40 years or 100 years, but in the evolutionary perspective of the whole history of the human race. In evolution, I'm going to draw on the chart pad a long horizontal line showing time. At the left end is the time 4 billion years ago when the earth was supposed to have been formed, according to the current scientific time estimates. Over here at the right end of the line will be the present. Along this huge time dimension there are a number of remarkable steps -- evolutionary steps, according to the fossil evidence in the rocks, with the new radioactive methods of dating the ancient fossils. One early step is

the creation of single-celled animals. Then there's the step of photosynthesis. There's the step later of multi-cellular animals. The nervous system. Eyes. The coming ashore of the land animals. There are these various steps by and by, when we begin we get to get mammals, birds, and flowers. And then when we get to the human race, this last 3 million years or so, there are remarkable steps of speech, of fire, of tools. And now in the last 10,000 years, since the glaciers have receded, we've had steps of the domestication of animals, of the invention of cities, of money, of the wheel. And one could go on and on, and we begin to know the technical history of the last 2,000 or 3,000 years quite well, those many steps that led up to this sort of technological civilization that we have today.

It's interesting to ask yourself the question, how many of the developments of the last 40 years or so, that I listed in the beginning, are important on this vast evolutionary scale of life on this planet? How do they compare with previous developments? It's hard to compare them unless you group them in some way into categories. You've got to compare similar things with similar things. Recently I've been making just such a comparison of "evolutionary jumps" today, in the last 40 years, with those in previous history. I thought it would be worth listing some of the remarkable jumps of the last 40 years which are very large, even when compared to the largest earlier changes.

Before I make such a comparison, perhaps I should emphasize that from a religious point of view, a Buddhist would never draw a curve like this, and perhaps not even a Muslim. This concept of progressive growth and evolution of the world and of human achievement and awareness can only come out of the Judeo-Christian tradition, which sees life and the history of humankind on earth as being a progress. The Judeo-Christian tradition has the idea of a "far-off, divine event, toward which the whole creation moves"; the idea of "the hand of God working in history," working through human beings. It has the idea of progressive change in our notions; first, a change to the idea of one God; then a change to the idea of a God of justice; then the idea of a God of love; then a change to the idea of loving your neighbor as yourself. Each of these represented an evolutionary jump in our perceptions which went on growing, as part of our Judeo-Christian heritage. It is this tradition that gives us the idea of asking ourselves, "Where are we going?" Whether it's towards the Messiah who is yet to come, as the Jews say, or whether it's toward a second coming, as the Christians would say, perhaps toward an

apocalyptic future -- the Jewish and Christian religions have been future-oriented, in a way that the other religions of the world have not. (I've always been surprised that, as I can make out, the Muslims lost this future-oriented component. Their philosophers and teachers are living much more in the past than our teachers in the Judeo-Christian tradition.)

Among these Judeo-Christian philosophers who are oriented toward the future is of course Teilhard de Chardin on the Catholic side, and our friend Moltmann, who is here, with his theology of hope. My wife used to say that I was reading so much Buber and Teilhard that I would die either a Jew or a Catholic. I've since then become much more intimate with the Teilhardians in Europe, and I think that Teilhard, the Jesuit evolutionist who wrote so much about the human spirit and the future, is one of the philosophers that anyone concerned with the Church and its role in the future ought to read over and over. There are parts of his Catholic doctrine that I as a Protestant don't understand very well, but the rest of his book, The Phenomenon of Man, written around 1935, reads as though it were written yesterday, as though he understood all of these changes in the world structure that have happened in the last 40 years.

So in studying our evolutionary changes today, I am looking at the progress of the human race toward more understanding, toward more integration, toward more communication, toward what Teilhard de Chardin called the noosphere. After the atmosphere, and then the biosphere of life, he envisioned the noosphere, the sphere of nous or mind or intelligence. Teilhard saw this as being built, in part, of our electrical communications, our radio -- and now our television around the world -- linking us into a single nervous system, so to speak, like the linking in the human brain itself. So I am looking at these jumps of the last 40 years from the point of view of asking the question, "Are they moving us in some appreciable way toward an improved form of human society, a form which is more aware, more loving, more linked-up and integrated than any of our hostile, ignorant, fearful societies in the past?"

With this question in mind, let me list some of these jumps in the last 40 years and compare them with previous jumps of somewhat the same sort as indicated in Table 1 [next page]. One of the big jumps in recent times has been "recombinant DNA", the great biological achievement which came around 1973, surprising many biologists. This is a form of genetic mixing which permits us to put genes from one species into another. There are now human insulin chains that have been put into bacteria growing in flasks

Table 1. A Classification of major evolutionary jumps.

Eras	Early life	Multi-cellular	Early human	Post-glacial	Modern	Present transformation
Time (yr BP)	4000 M --	1000 M --	2 M --	10,000 --	600 --	40 --
<u>Functional areas</u>						
Genetic mixing and control	SEX-CROSSING	Migration		<u>DOMESTICATION AND BREEDING</u>	DISEASE-CONTROL, CONTRACEPTION	<u>MOLECULAR BIOLOGY, RECOMBINANT DNA</u>
Energy conversion	<u>PHOTOSYNTHESIS</u>	PLANT-EATING	FIRE	AGRICULTURE wind, hydro	COAL-STEAM, ELECTRICITY	NUCLEAR FISSION, (FUSION) <u>SOLAR ELECTRIC, (SPACE POWER)</u>
Encapsulation and habitats	CELLS ocean niches	Shell, skin, bark <u>LAND</u>	Clothes all climates	CITIES all continents	West "frontier"	<u>SPACE CAPSULES, (SETTLEMENTS)</u> Arctic, ocean
Methods of travel	Drift	Fins, feet, wings	Boats	Horses, <u>WHEELS SHIPS</u>	RAILROAD, AUTO, AIRPLANE	Jet, <u>ROCKET</u>
Tools and weapons	Chemical	Teeth, claws	<u>TOOLS, WEAPONS</u>	METAL	MACHINES, GUNS, EXPLOSIVES	<u>AUTOMATION, ROCKETS,</u> <u>NUCLEAR WEAPONS</u>
Detection and signaling	Chemical	HEARING, <u>VISION,</u> echo-location	SPEECH	WRITING	PRINTING telephone, radio	ELECTROMAGNETIC SPECTRUM-- RADAR, Laser, <u>TELEVISION</u>
Problem-solving and storage	DNA CHAINS	<u>NERVOUS SYSTEM AND BRAINS</u>	Oral memory, prediction	MATH, SCIENCE LOGIC	SCIENCE- TECHNOLOGY	<u>ELECTRONIC DATA-PROCESSING,</u> <u>FEEDBACK CONTROL</u>
Mechanisms of change	Accident and SELECTION	Foresight, REINFORCEMENT	<u>THOUGHT</u>	INVENTION	RESEARCH AND DEVELOPMENT	<u>SYSTEMS-ANALYSIS AND</u> <u>DESIGN PROJECTS</u>

in San Francisco; and they are presumably able to make human insulin by the kilogram for the help of diabetics. There's great danger of course; there always is, in these powerful new methods if we don't have control or don't have understanding. But right now I'm not talking about the dangers; I'm talking about how big these new developments are in terms of previous change. Our greatest previous method of genetic mixing between the genes of different creatures was sex -- that is, sexual crossing between male and female. Biologists believe it goes back to the bacteria; and since bacteria have now been discovered in the rocks of 3 billion years ago, it means 3 billion years of sex. The greatest speedup later in genetic mixing came with the domestication of plants and animals, which came after the end of the Ice Age. It came about 8,000 years ago. But it was not a change in sexual crossing, it was simply a change in the speed of selection. So human beings could create a new species of cow or dog in a hundred years or so by breeding and selection, instead of having to wait 5 million years for natural selection to do the job. It was still sexual crossing. It still required that male and female genes be almost alike when they crossed -- that's what you meant when you talked about male and female "of the same species." But now we can cross anything with anything else: bacteria, yeasts, fungi, plants, animals. We can invent new species, it looks like perhaps millions of them. Recombinant DNA methods go as far beyond sexual crossing of similar male and female genes as the atom bomb goes beyond the use of a stick as weapon.

Another big jump in recent times has been the jump in our methods of getting and converting energy. I want to list solar-electric power, along with nuclear power, in this last 40 years, as being as important to the future of the human race as the invention of photosynthesis was, when it was developed by green plants something like 2 billion years ago. Almost all of the energy sources of living creatures up until now have been based on photosynthesis: animal eats plants -- photosynthesis; we burn wood -- photosynthesis; we burn coal -- photosynthesis. The invention of fire by early man was just a method of making photosynthesis more concentrated for us. But now we invent ways which go beyond photosynthesis (even beyond wind and water power, which were the other two solar sources of energy in the past) with solar "photovoltaic" cells. Satellites have them, ships have them for charging batteries. In principle, they're much more efficient ways than photosynthesis for converting this vast energy of sunlight which is pouring down on us, into forms of electrical energy for our use. At present these solar cells are not yet economical, but it is believed that by 1985 they may be competing with coal and nuclear

power, giving us rooftop solar-electric or solar-electric systems in space which can beam electric power down to us. This may be as important for the next million years or the next billion years as photosynthesis has been. We will never give up photosynthesis because it makes important chemicals. But here we have a way of getting electric power directly from the sun without going through the chemical stage, and the sun is pouring down billions of times as much power as we use. Even on this earth we only use 1/10,000th of this power that is pouring down from the sun all the time. And what we need to do is enlarge that. That's the answer to our energy bottleneck in the long run, and even possibly in the next 30 years.

We can pass lightly over the development of rockets, traveling in space, in the last 40 years. But they are surely as big a jump as ships able to travel across the ocean that were invented a few thousand years ago.

What is much more important today is the whole space jump -- men living and working in space (and someday perhaps women) and the possibility of factories in space, the possibility of space habitats or cities in space such as Gerard O'Neill talks about. I think this human leap into a new medium can only be compared to the coming ashore of the land animals, which happened something like a billion years ago. This is a new kind of habitat. We've only begun to go into space, but it's very much like that first lungfish coming ashore on the land. All the other fish said, "What an unfishy thing to do! How will you survive? The sun will dry you out and the ultraviolet will kill you and you won't be able to communicate by all your sonar systems and electric detection." But somehow or another the lungfish made it and explored many new niches such as had never existed before. I myself think that space will offer us in the long run -- and perhaps even in the short run, in a hundred years or less -- many new niches, many new modes of living and working, a great expansion of the human potentiality.

Another recent jump is the development of nuclear missiles that can go around the world in a half hour, which can wipe us all out in a three-hour exchange. They are the most recent example growing out of our great initial discovery of tools and weapons, which seems to have happened some 3 million years ago with the coming of the first human beings, homo habilis in Africa, according to the researches of Leakey (those first tools and weapons with which you could club somebody right next to you, or kill an animal or you could begin to make fire). But the 10,000-mile nuclear

missiles and other forms of tools that we have today, such as automation, are orders of magnitude beyond even our early 20th century tools and weapons.

Another enormous jump today is television and radar, and in fact, the whole electric or electronic world of communication and detection. In the field of signaling and detection, I think it can only be compared with the evolutionary development of eyes. Eyes have been developed four different times in evolution: in the vertebrates like us, in the octopus (the mollusks), in the insects, and now George Wald has found some marine worms with eyes in the Mediterranean. Each of these was an independent development by a different type of evolution. This means that, in some sense, eyes are inevitable, when nervous systems get to a certain complexity -- when the eye spots that detect light and shadow all come together in a little retina at the back of an eyeball. The result suddenly is that the creature that could detect only light and shadow, can now see at a distance. Now it can see prey or see predators coming. It can make plans. It can take evasive action. I have a saying that you have to have sight before you can have foresight. And you can imagine what the coming of eyes did to the whole possibility of development of biological species, to the whole possibility of communication between animals. But what a new leap this is today! We suddenly have this television and electronics which links together half the human race with a new mode of perception that can see around the earth, through night and fog, to the mountains of Mars, or the surface of Venus. We have this new electronic method of sharing our sports, science, politics, all our experience with each other. I think that the long run consequences of the electronic society, of electronic detection and perception, may be as vast for the human race as the invention of eyes.

In another field, in the last 40 years, we have acquired electronic data processing and feedback control, in our methods of problem-solving. My feeling is that this new data processing which links us all together with computers, which links us together with credit cards and with bank records and social security records, and which solves our science problems at rates we could never have believed before, needs to be compared with the nervous system. It is like a social nervous system which is spreading and linking us all together in ways we could never have believed before. And all of this is tied together by our great systems analysis groups which have created many of these new developments, such developments as the Apollo project with

100,000 people working together to send people to the moon, with the Manhattan project with 100,000 people working together to create the atom bomb. These are methods of analytical thought, but they are thought about the future. They are new methods for the creation of the future in a systematic way, which is a kind of collective social equivalent to the development of human thought and foresight, probably 3 million years ago or thereabouts, whenever human speech, language and ideas came in.

The result is that we have some developments today which are as rapid and tremendous as any of the developments in all previous history. It's interesting to see certain aspects of these developments which stand out when you see them all together like this. One is their surprise, but another is their inevitability. Essentially, before you have eyes, you can't imagine what it would be like to have eyes. And so when you get eyes, suddenly you see a whole world surrounding you that you never saw before. You couldn't imagine it from the time before. Before you have wings, the little flying squirrel drifts from tree to tree and doesn't have actual functioning wings, it can hardly imagine what it would be like to fly for 10,000 miles or to feed from the air or to nest on cliffs. So these jumps surprise us -- yet they rush us into the future so that we cannot turn back. It is somewhat like coming over a hill into a valley and there in the valley all the streams run together into some big river continuing down. We don't know where the rivers are going when we come over the hill, but when we get in the valley we suddenly find out that we are in the midst of a kind of multiple waterfall rushing us toward some conclusion. One might say that these waterfalls that rush us into the future are like the hand of God. Many of our new developments have an inevitable character. They go back 100 years to Faraday; they go back 600 years to the invention of gunpowder or the mariner's compass; they go back 2,000 years to the Greeks. Probably there's no stage along the road where we could have stopped or turned back. So we have a combination of surprise mixed with the inevitability of this new world.

The second thing to note about all these developments is the speedup in recent times: the speedup in the last 3 million years, the speedup in the last 10,000 years, the speedup in the last few hundred years and now suddenly this enormous speedup in the last 40 years. This speedup is an acceleration of change of the sort that Toffler was talking about. And when I talked earlier about an S-curve, like the curve of growth toward the limits of a flask, I was exaggerating. In fact, I was saying something slightly wrong.

An S-curve falls short of an exponential change; it's a sub-exponential. These changes today are not sub-exponentials, they're super-exponentials. They go faster in every generation up until the present. There are only two processes I know of in physics or biology which are super-exponential in this way. One of them is the fracture of a metal: the little cracks get bigger and bigger, they unite, and by and by the metal suddenly breaks completely in two. Kenneth Boulding has called our present state today a "system break," and he's using that metaphor.

But I prefer the other metaphor: the biological metaphor of the super-exponential process that we call the moment of birth. In birth, one has the same speedup toward the end. These were the nine months when nothing much was happening, with one day not so very different from the day before. But then by and by, the baby drops; and by and by, you begin to have labor pains; by and by, the bag of waters breaks; and by and by, that head begins to appear; and the mother may wish, "Gee, I'm sorry I got into this. Can't we back up and avoid this terrible pain?" And in the same way many of us today wish we could go back and start over. But it's now too late. The hand of God is on us. We are in the midst of an evolutionary process which is driving us toward a moment of birth. Suddenly there's a speedup, the baby is born, and within a few seconds or a few minutes it has to learn to do things it never did in the womb before. It has to learn to breathe, to cry, to sweat, to excrete. If it fails to do any of these things, it dies. And so we have to learn to use these enormous new powers which have come upon us so suddenly, in just the next few minutes of our lives, so to speak, or we die and the human experiment expires.

We have been building for a long time toward this sudden moment of change today. Let me emphasize how sudden it is. It is so sudden that on this 4 billion year scale, the 3 million years of the human race is narrower than any line I can draw on this graph, a millimeter of width, if the graph is a meter across. Yet if I spread out that 3 million years so that it makes a new line a meter long, to the present, then our last 40 years, out of the 3 million, is sharper than any line I can draw with my little Swiss pocket knife. It's one-hundredth of a millimeter wide. We are now on a knife edge of a knife edge in terms of evolutionary history, in terms of destiny, in terms of what the human race is about to become.

And in that knife edge of a knife edge, in the next 20 years or 30 years, we have to learn to manage these new powers, like a moment of birth, as we move into a totally new human future. We have to learn to do it not by the

methods that babies have had. Every baby is a descendent of a long line of babies who survived at birth. The ones that die don't turn out to be ancestors. So the baby has already built into it those necessary instructions, those DNA plans, for how to breathe, how to sweat, how to cry. But our human world society today is unique. It does not have any built-in instructions or previous example before, in all of human history, of the sort of global organization that is needed for survival. The result is we now must begin to solve these new problems on this vast scale by anticipation, by futures studies, by lookout studies and by conferences like this, in which we see what is ahead, what needs to be done, and in which we get ourselves the commitment to go on and do it.

I think it is in this sense that the hand of destiny is upon us. It's in this sense that the moment of birth is a very dangerous moment, the most dangerous moment in the whole history of the baby. And yet at the same time, it is the moment in which the future is determined. The future starts from this point with a new lease on life on the Earth for the whole human race. I see us as being called to a great mission, in order to create a world fit for our grandchildren to live in. It is a delight to be taking part in a conference of this sort, where you too feel called by the same mission. At this moment of birth, we are at the creative center of the evolutionary process, shaping the future for a million years to come.