RESPONSIBLE FOR YOUR ROSE

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I have been involved in futures studies for a long time--essentially since the early 1960s while I was teaching in the College of Law and Politics of Rikkyo University in Tokyo, Japan. So as what was once upon a time "the future" becomes first the present and then the past, I have had many occasions to reflect on what I once thought the future was going to be like in comparison to what the present now seems to be-- knowing full well that, just as there are many "alternative futures", there are also many "alternative presents" and "alternative pasts"--many different ways, each in some ways correct, to describe what is and what was.

While no respectable futurist tries to "predict" the future (in the literal sense of that term: to say beforehand what WILL BE), futurists do "forecast" "alternative futures" and do help others to envision and strive to achieve "preferred futures."

As I look back over my forecasts, or the forecasts of others which I accepted, I believe it is fair for me to say that, on average, the forecasts were pretty good; certainly better than chance; far more often on or near the mark than seriously wrong. Oh, there have certainly been some spectacular forecasting failures on my part, but all in all, not bad.

But as a futures/activist--as a person who has tried to help others envision and achieve their preferred futures--I have been a total failure.

I get little satisfaction from being able to say "I told you so" if my telling made no difference in the attitudes and behaviors of those who heard my tales. I was more interested in being effective than in being correct. And since I was seldom effective, I my life has been a failure.

That is to say, while much about the present and the emerging future is as I anticipated it might be, the way most people in the West/North feel about the present and the future--the beliefs and actions of people presently in response to the world in which they live--reveals that they are living in one world in their minds while the "real world" around them is something else.

Years ago, Alvin Toffler coined the term "future shock" to describe this phenomenon--the reaction of people who find themselves in an environment contrary to the one they anticipated. While much of the world is as we forecast it, most people in the West seem to be "living" in a quite different place, in a world of dreams and reveries partly nostalgic, partly futuristic, but all basically ignoring, if not affirmatively denying, what is going on around them.

Let me stop being so abstract here and give concrete examples of what I mean.

Here are some of the early statements by futurists which I found convincing:

1. The Coming Information Society.
In many ways, futurists have been spectacularly correct in their forecasts of the "coming information society". I would say that, all in all, the following folks,

writing between the 1950s and 1970s, were right on the mark in forecasting major social change as a consequence of technology, especially communication technologies. Since most early futurists focused on this factor, the list is long indeed:

Kurt Baier and Nicholas Rescher, <u>Values and the future. The impact of technological change on American values</u>. Free Press, 1969

Daniel Bell, <u>The coming of post-industrial society. A venture in social forecasting</u>. Basic Books, 1973

John Diebold, <u>Automation, the advent of the automatic factory</u>. Van Nostrand, 1952

John Diebold, <u>Man and the computer: Technology as an agent of social change</u>. Praeger, 1969

Peter Drucker, <u>America's next twenty years</u>. Harper 1957

Peter Drucker, <u>The new society</u>. Harper, 1950

Don Fabun, <u>The dynamics of change</u>. Prentice-Hall, 1967

Buckminster Fuller, <u>Utopia or oblivion: The prospects for humanity</u>. Bantam Books, 1969

John Kenneth Galbraith, <u>The affluent society</u>. Houghton Mifflin, 1958

John Kenneth Galbraith, <u>The new industrial state</u>. Houghton-Mifflin, 1967

Eli Ginzberg, ed., <u>Technology and social change</u>. Columbia University Press, 1964

Martin Greenberger, ed., <u>Computers and the world of the future</u>. MIT Press, 1962

Daniel S. Halacy, Jr., <u>Computers: The machines we think with</u>. Harper and Row, 1962

The Institute of History of Natural Sciences and Technology, and the Institute of Philosophy of the Academy of Sciences of the USSR, and the Institute of Philosophy and Sociology of the Czechoslovak Academy of Sciences, <u>Man--Science--Technology. A Marxist analysis of the scientific-technological revolution</u>. Prague: Academia, 1973

John McHale, <u>World facts and trends</u>. 2d ed. Macmillan, 1972

John McHale, <u>The changing information environment.</u> Westview Press, 1976.

Marshall McLuhan, <u>Understanding media</u>. Singer, 1963

Marshall McLuhan, <u>The medium is the message</u>, Bantam, 1967

Emmanuel Mesthene, ed., <u>Technology and social change</u>. Bobbs-Merrill, 1967

Emmanuel Mesthene, <u>Technological change. Its impact on man and society</u>. New York: Signet Books, 1970

Donald Michael, <u>Cybernation. The silent conquest</u>. Center for the Study of Democratic Institutions, 1963

Donald Michael, <u>The unprepared society: Planning for a precarious future</u>. Basic Books, 1968

Herbert Muller, <u>The children of Frankenstein: A primer on modern technology and human values</u>. Indiana University Press, 1970

Lewis Mumford, <u>The myth of the machine. Technics and human development</u>. New York: Harcourt, Brace & World, 1966

Hasan Ozbekhan, <u>Technology and man's future</u>. Rand, 1966

Donald Schon, <u>Technology and change: The new Heraclitus</u>. Delacorte, 1967

Ben B. Seligman, <u>Most notorious victory: Man in an age of automation</u>. Free Press, 1966

Morris Philipson, ed., <u>Automation: Implications for the future</u>. Vintage, 1962

Robert Prehoda, <u>Designing the future. The role of technological forecasting</u>. Philadelphia: Chilton Book Company, 1967

Robert Theobald, <u>The challenge of abundance</u>. Potter, 1961

Lynn White, <u>Medieval technology and social change</u>. Oxford, 1962

True, people still chide futurists for forecasting a "paperless society" while the world is using more paper than ever before. But mark my words: the paperless society clearly is on the way. We were talking about the 21st Century, for heaven's sake, and we're still in the 20th!

And true, people are far more resistant to "telework" than I imagined they would be (mainly the people who insist on erecting buildings "downtown" continue to do so, and bosses continue to like to be able to see their dwindling number of workers actually working) but here again, there ARE more people teleworking every day, and there will be more and more until it becomes the norm.

If people work at all.

2. The End of Work.
        While futurists were generally correct in anticipating a "coming information society" they do not seem to have been correct in certain other aspects of it. One has to do with the "end of work", a theme which I myself advanced in the very first article I wrote about the future, titled "Oh we belong to a cybernetic, post-money, situational ethics society, my baby and me," and excerpted in <u>The Futurist</u>, August 1967 as "Valuelessness and the plastic personality." This was reprinted recently in <u>Futures</u>, September 1997 with comments by Devin Nordberg, Jordi Serra, Chris Jones and Rick Slaughter.

While I was still in Japan, in 1964, during the very earliest days of futures studies, I

had been influenced by reports of a "Conference on the Cybercultural Revolution--Cybernetics and Automation." First of all, please note this term, "cyberculture". It is not true that the concept was recently invented by William Gibson, the author of the science fiction novel, Neuromancer (Ace Science Fiction Books, 1984), although Gibson certainly made it popular once the technology forecast in 1964 came into existence, in whole or in part in the late 1980s, 90s, and beyond.

However, my main point is that the 1964 Conference issued a "Manifesto of the Ad Hoc Committee on the Triple Revolution". The three parts they identified and discussed were the Cybernation Revolution, the Weaponry Revolution, and the Human Rights Revolution [A good discussion of the Manifesto is found in Henry Winthrop, Ventures in social interpretation. New York: Appleton-Century-Croft, 1968, Chapter 3, "The Sociological and Ideological Assumptions Underlying Cybernation." See also Robert Perrucci and Marc Pilisuk, eds., The triple revolution. Social problems in depth. Boston: Little, Brown, 1968]. I believe that the Manifesto was correct on all three counts--cybernation and automation has rendered work largely unnecessary; nuclear weapons has made war unwinnable and untenable as an instrument of national policy; and the human rights revolution has ended the legitimacy and morality of racial, gender, and all other kinds of prejudice.

While war and prejudice most certainly still exists, the basic point of the Manifesto was absolutely on the mark for those two obsolete practices, and governments and people everywhere have gone a long way (though there is much, much more to be done!) in the direction pointed to by the Manifesto.

The Manifesto was also correct about "cyberculture" and the end of work as well, I believe. However, the forces which enjoy excessive power and privilege now because of the unnecessary, unethical, and growing global maldistribution of wealth, have actively and successfully prevented the social change which the Manifesto saw as possible and desirable. Indeed, during the 1980s, through their control of education, advertising, and the media, the wealthy were able to make greed and excess fashionable, popular, and seemingly inevitable and right, so that most people in the West/North seem to believe that work is necessary, and that the rich and poor both deserve what they have, and don't have.

But the fact that most human manual and mental labor is no longer needed, and that the need for labor will virtually vanish in the foreseeable future has resurfaced again. In an article in the Utne Reader, May-June 1995, adapted from his book, The End of Work: the Decline of the Global Labor Force and the Dawn of the Post-Market Era, Jeremy Rifkin writes:
    "From the beginning, civilization--as well as people's daily lives--has been structured in large part around the concept of work. But now, for the first time in history, human labor is being systematically eliminated from the economic process. In the coming century, employment, as we have come to know it, is likely to be phased out in most of the industrial nations of the world. A new generation of sophisticated information and communication technologies is being introduced into a wide variety of work situations. These machines, together with new forms of business reorganization and management, are forcing millions of blue- and white-collar workers into temporary jobs and unemployment lines--or worse, breadlines."

A more recent article by David Peace Snyder, "The Revolution in the Workplace: What's Happening to our Jobs?" The Futurist, March-April 1996, says, "While it may be of little comfort to the growing millions of displaced, underpaid workers of the

industrial world, a number of futurists anticipated this historic moment 25 to 30 years ago, and the accurately described the social and economic consequences of the Information Revolution in considerable detail." (p 10).

Snyder then goes on to refer to a piece by Donald Michael, also in The Futurist (April 1967) Donald Schon's Technology and change (1967), The temporary society (1968) by Warren Bennis and Philip Slater, Ian Wilson's Our future business environment (1969) and of course Daniel Bell's The Coming of the post-industrial society (1973).

Another aspect of the "Coming Information Society" is the emergence of artificial intelligence, which I am going to touch on later. But let me say here that even though the original forecasts of early success were way off--it has proven much easier to develop machines that can think as well or better than humans than it is to develop machines that can sense and move as well as we can--thinking machines are all around, and many more are on the way, while humanlike intelligent androids are still a way off (but still coming).

So all in all, I conclude we were impressively accurate in forecasting most aspects of the Information Society.

3. The Limits to Growth?
One area about which many futurists were most urgent but where the general public and formal policy makers have paid little or no attention, is in the area of the environment.

There have always been voices opposed to policies which destroy land, uproot peoples--often native peoples--and pollute and waste the environment. Harrison Brown, for one, published The challenge of man's future in 1954, and The next hundred years. Man's natural and technological resources in 1957, and there were many before him.

However, the modern "environmental movement" usually traces its origins to a book by Rachel Carson called The Silent Spring (1962). Carson focused primarily on the growing indiscriminate use of pesticides, such as the now-outlawed DDT, which, she feared, would end up not only killing the pests for which it was intended, but the birds who fed upon the bugs. No bugs, no birds, and no birds chirping. Hence, a "silent spring."

Carson was also pointing out the "ecological" nature of things, their interconnectedness--that it is impossible to "just do one thing;" that simple minded economic growth is blind to the many unintended and deadly consequences of its actions. We live in a net of connectivity, a web of life. Destroy one part and you damage, and may destroy, all parts, even if you are unaware of that.

Shortly after Carson, there were other voices, most prominent that of Paul Ehrlich who wrote The Population Bomb (1968) which pointed out that human population growth was out of control, and had to be checked.

There were many other similar expressions of concern (among them, William Ewald. Jr., ed., [Three volumes, each subtitled "The next 50 years]: Environment and change, Environment and Policy; Environment for Man. Bloomington: Indiana University Press, 1968, Stuart Udall, 1976: Agenda for tomorrow. Harcourt, Brace and World, 1968, John McHale, World facts and trends. 2d ed. Macmillan, 1972, and John McHale, The

ecological context. G. Braziller, 1970). But the one which was the most prominent and controversial by far was the book written by Donella and Dennis Meadows, Jorgen Randers, and William Behrens III called The Limits to Growth (1972).

This book of course was commissioned by the Club of Rome, itself created by Aureilo Peccei who had himself written a book several years earlier called The Chasm Ahead in 1969 in which he pointed out the horrendous problems the world was about to face because of overpopulation, resource exhaustion, and pollution. These issues were all global, looming, and interrelated, so Peccei called them "The Global Problematique."

Because the Problematique was such a massive and interrelated phenomenon, Peccei believed that it was ripe for computer modeling, and so he contacted Jay Forrester of MIT who had developed several impressive computer models of complex processes. Forrester, in turn, engaged the Meadows, et al., to use his computer model to simulate the Problematique. The results of the computer simulation were impressive--and alarming: unless the economic and political system changed dramatically and quickly, the global environmental system would collapse in the 21st Century.

The results of The Limits to Growth were very widely publicized in virtually all countries, across most academic disciplines, in many languages, in hopes of challenging people to action.

And there was lots of action, some of it helpful. And there was a torrent of criticism and rebuke.

Indeed in 1972, I wrote a little article, called "The Limits to 'The Limits to Growth'" which was reprinted in a number of places, in which I basically made three points:

1. The concerns of the LTG are in no way new, and even their conclusions are not new. It was already all in Peccei's original book. I myself, I immodestly said, had made similar points in a speech I had given before a joint session of the Hawaii State Legislature two years earlier--and yet the book was written, and publicized as though it were startling new information, which it was not. However, if it gets the word out more effectively, that will be wonderful, I said.

2. The authors of the LTG stated over and over again that they were not predicting the future, but were urging people to act so as to prevent the future their computer program forecast. However, people generally took it as a prediction, which they either accepted or rejected, in either case as a matter of emotional faith.

3. Finally--and here is where I was wrong--it was so clear to me that the warnings of the LTG deserved serious consideration and positive pro-action, and that the changes required would in any event have resulted in a world so vastly improved that even if the forecasts were utterly wrong they should and would be adopted, that I chided the authors for being so shrill on the one hand and so timid on the other. The changes in values, behavior, institutions and technologies they wanted were already well on the way, I believed. Not to worry, I concluded. Calm down, I said. The "coming information society" will bring with it also the less populated, more ecologically-benign future the LTG wanted, I was certain.

Indeed, things were looking up! So, by the end of the 1970s, the Democratic Party handlers of US President Jimmie Carter authorized Gerald Barney to survey the future of the world. The resulting Global 2000 Report to the President made it crystal

clear, in enormous detail, that all studies showed that the world was on a path to ecological destruction. Surely that would be the last such report the world would need! Surely the American and all other governments would change their policies in order to prevent the future which had been now clearly foreseen and announced for almost three decades!

Well, I was utterly wrong.

So, 20 years later, in 1992, the Meadows revisited their computer model, surveyed what had and had not happened in the intervening years, and published a new book, titled, Beyond the Limits. The title says it all: many vital processes are already "beyond the limits" of sustainability. We're already well down the drain.

Of course, the Meadows continued to try to be upbeat about it, urging us all to positive, prompt, honest, and loving action. But the figures seemed to indicate hopelessness, especially given the fact that not many people were paying attention to the issue at all.

But then, in the same year, in June 1992, a UN-sponsored "Earth Summit" was held in Rio de Janeiro, Brazil. The most recent in a series of global environmental summits which began in Stockholm in 1972, the Rio Conference issued an impressive Agenda 21 in which the countries of the world pledged to take action on a whole series of environmental and resource issues in order to stave off calamity.

Surely that signified the beginning of real and effective action!

No. Few if any of the items on the Agenda are on track towards being achieved globally. So, if the concerns of the Meadows--and many others--are valid, the future of the world looks very, very bleak indeed.

And then, just as few months ago, hope raised its tattered head again as another Democratic Party President, with his "environmental" Vice President standing by, solemnly announced that "global warming is real" and that something effective and urgent should be done about it.

But in the very next sentence, he made it clear that HE certainly doesn't intend to suggest anything specific be done because neither the American people nor the American Congress would permit, much less support, the policies which the future of the globe requires.

So, hang on world, we're coming to the end!

4. Grow or Die.
        But maybe not. Throughout this entire period, plenty of other futurists were raising their voices in opposition to environmental warnings, saying that all of this concern about the environment is nothing but hog wash at best--irresponsible fearmongering by "pointy-headed professors who can't park their bicycles straight," as Governor George Wallace of Alabama once said.

Others asserted that the various pitiful prophecies of doom are more truly merely special pleading by environmental researchers who are only trying to get more research funds for their pet schemes. This is the contention of Ronald Bailey, the author of EcoScam: False Prophets of Ecological Apocalypse. (1993), and The True State

<u>of the Planet</u> (1995), written in rebuttal to the gloomy annual <u>State of the Planet</u> reports by Lester Brown and the Worldwatch Institute

Herman Kahn was of course for many years the main, brilliant proponent of this anti-environmental, pro-growth view, best exemplified in the "Long Term Multifold Trend" of his seminal book, <u>The Year 2000</u> (1967) and then more argumentatively in <u>The Next Two Hundred Years</u> (1976) and especially <u>This Resourceful Earth</u> (1980) which was specifically written as a rebuttal of Barney's <u>Global 2000</u> Report.

Unlike the Meadows, Gerald Barney, Paul Ehrlich, Lester Brown (or myself), Kahn was extraordinarily effective. His think tank, the Hudson Institute, contributed significantly to the creation of the Heritage Foundation, which was the main "intellectual" force in back of the defeat of Jimmie Carter and the election of Ronald Reagan, providing the rationale for all of the anti-environmental, pro-military, anti-government, and pro-economic growth rhetoric and policies of "Reaganomics" which still enthrall most Americans, and, it seems, the world.

Herman Kahn and his buddies were the only futurists I know of who were successful in making their dreams come true. The rest of us just fumed and fumbled.

When Kahn died, his co-editor of <u>This Resourceful Earth,</u> Julian Simon, took over the helm of the Good Ship Panglossia, and remains tireless in his continuing insistence that there is nothing to fear but fear itself.

Consider these excerpts from Julian Simon's, <u>The Ultimate Resource 2</u> (1996) a very lengthy and repetitive book in which he asserts over and over that every one of the environmentalists' concerns are utterly wrong in every detail:

"<u>Food</u>. Contrary to popular impression, food production per capita has been increasing for the half-century since World War II....We also know that famine has progressively diminished for at least the past century. Average height has increased in developed countries in recent centuries, a sign that people are eating better. And there is compelling reason to believe that human nutrition will continue to improve into the indefinite future, even with continued population growth.

"<u>Land</u>. Agricultural land is not a fixed resource. Rather, the amount of agricultural land has been increasing substantially, and it is likely to continue to increase where needed. Paradoxically, in the countries that are best supplied with food, such as the United States, the quantity of land under cultivation has been decreasing because it is more economical to raise larger yields on less land than to increase the total amount of farmland. For this reason, among others, the amount of land used for forests, recreation, and wildlife has been increasingly rapidly in the United States....

"<u>Natural resources</u>. ...[O]ur supplies of natural resources are not finite in any economic sense. Nor does past experience give reason to expect natural resources to become more scarce, Rather, if history is any guide, natural resources will progressively become less costly, hence less scarce, and will constitute a smaller proportion of our expenses in future year. Population growth is likely to have long-run beneficial impact on the natural-resources situation.

"<u>Energy</u>. ...[T]he long-run future of our energy supply is at least as bright as that of any other natural resources, though government intervention can

temporarily boost prices from time to time. Finiteness is no problem here either. And the long-run impact of additional people is likely to speed the development of cheap energy supplies that are almost inexhaustible.

"Pollution.   ...[P]opulation growth is not the villain in the creation and reduction of pollution. And the key trend is that life expectancy, which is the best overall index of the pollution level, has improved markedly as the world's population has grown. This reflects the enormous decline during the past couple of centuries in the most important pollutions--diseases borne by air and water.

"Standard of living....[P]er capita income is likely to be higher with a growing population than with a stationary one, both in more-developed and less-developed countries. ...

"Human fertility. The contention that poor and uneducated people breed without constraint is demonstrably wrong, even for the poorest and most 'primitive' societies. Well-off people who believe that the poor do not weigh the consequences of having more children are simply arrogant, or ignorant, or both.

"Future population growth. "Present trends suggest that even though total population for the world is increasing, the density of population on most of the world's surface will decrease. This is already happening in the developed countries." "As the poor countries become richer, they will surely experience the same trends, leaving most of the world's surface progressively less populated....

"To sum up the argument of the book: in the short run, all resources are limited. ... The long run, however, is a different story. The standard of living has risen along with the size of the world's population since the beginning of recorded time. There is no convincing economic reason why these trends toward a better life should not continue indefinitely."

"To repeat, every forecast of the doomsayers has turned out flat wrong. Metals, foods, and other natural resources have become more available rather than more scarce throughout the centuries. The Famine 1975! forecast by the Paddock brothers that we would see famine deaths in the United States on television was followed by gluts in agricultural markets. After Paul Ehrlich's primal scream--'What will we do when the [gasoline] pumps run dry?'--gasoline became cheaper than since the 1930s. The Great Lakes are not dead; instead they offer better sport fishing than ever. The main pollutants, especially the particulates which have killed people for years, have lessened in our cities."

"In 1970 Paul Ehrlich wrote, 'If I were a gambler, I would take even money that England will not exist in the year 2000.' In an exchange with him in 1980, I offered to take that bet, or more realistically, wager that natural resources would become cheaper rather than more expensive. Professor Ehrlich and two colleagues said they would 'accept Simon's astonishing offer before other greedy people jump in.' And he said that 'the lure of easy money can be irresistible.' They chose five metals--copper, chrome, nickel, tin, and tungsten--and a ten-year period.

"At settling time in September 1990 not only the sum of the prices, but also the price of each individual metal, had fallen. But it is not surprising. The odds were all against them because the prices of metals have been falling throughout human history. From my point of view, the bet was like shooting fish in a barrel. Of course, I

offered to make the same bet again, at increased stakes, but the Ehrlich group has not taken up the offer."

"I'll bet that just about any environmental and economic trend pertaining to basic human material welfare (though not, of course, the progress of this group compared to that one) will show improvement in the long run. Will the doomsayers now put their money where their mouths are?"

"This is a public offer to stake $10,000, in separate transactions of $1,000 or $100 each, on my belief that mineral resources (or food or other commodities) will not rise in price in future years, adjusted for inflation. You choose any mineral or other raw material (including grain and fossil fuels) that is not government controlled, and the date of settlement." (35)

"This offer includes betting on any explicit or implicit prediction made in this book about the rate of specific extinctions; whether the Earth's forested area is increasing or decreasing; possible ill effects of any ozone-layer depletion and greenhouse warming, and infant mortality and lots, lots more."

"We are certainly capable of doing ourselves in with faulty political decisions, and again and again societies show that we do so. But I consider the odds to be against such bad outcomes continuing into the future. And I'm only offering to bet; I do not guarantee a rosier future in all aspects as a sure thing." (36)

There are many more people who could be quoted, pro and con, in the Growth/Limits to Growth debate. So what are we to make of all this? Will the real future please stand up?

5. Responsible for your rose.
I have long ago concluded that both the Grow or Die and the Limits to Growth people are correct--and incorrect. It is true that the Earth cannot sustain the continuing insults we are wasting on her. But it is too late to "stop" and go back--and I see no evidence of our doing that anyway.

And so I conclude, as I say in the title to my paper, that we must try to become "Responsible for our rose".

Humans were once a tiny part of nature, no more consequential than any of the other flora and fauna of Earth and substantially less numerous or powerful than most. However, over the millennia, and especially over the last several hundred years, and most especially within the last few decades, humans have become the dominant species on Earth. We have transformed what was once a "natural" environment of which we were only a small part, into a largely and increasingly "artificial" environment of our own creation.

It is of utmost importance that we understand this change in the human position, and our pressing and novel responsibilities for the future which follow from it, whether we like it, or are ready for it, or not. Walter Truett Anderson reminds us what Antoine de Saint-Exupery wrote in The Little Prince: "People have forgotten this truth, but you must not forget it. You become responsible forever for what you have tamed. You are responsible for your rose."

Over a decade ago Walter Truett Anderson opened his book, To Govern Evolution, as

follows:

"Evolution no longer follows the Darwinian rules that provided, for over a century, our best understanding of it. It is no longer an impersonal and mechanistic process obeying the remorseless logic of natural selection. That vision is as obsolete as its first cousin, Newton's clockwork cosmos. Today the driving force in evolution is human intelligence. Species survive or perish because of what people do to them and to their environments. The land and air and water system are massively altered by humankind which has become, as one scientist put it, ' a new geological force.' Even our own genetic future is in our hands, guided not by Darwinian abstractions but by science and medical technology and public policy. The world has changed; and the human species, which has wrought the change, is now being required to change in response to the conditions we have created."

"I am not here to argue that the human species ought to take responsibility for evolution on the planet, and begin through public and private institutions to make collective decisions about such matters. If that were the question to be decided I would advocate that we put it off for a few centuries or more--let things run themselves while we get accustomed to the idea of evolutionary governance, develop the appropriate ethics and myths and political structures, and perhaps mature a bit. However, that is not the question before us, since we are already governing evolution. This is the great paradox about the threshold: It is not out there ahead of us somewhere, a line from which we might conceivably draw back. We are well across it. To say that we are not ready for evolutionary governance is equivalent to saying that a teenage child is not ready for puberty; the statement may be true, but it is not much help."

"We have made the transition into acts of evolutionary governance, but we have not yet developed a concept of evolutionary governance. ... This is the project of the coming era: to create a social and political order--a global one--commensurate to human power in nature. The project requires a shift from evolutionary meddling to evolutionary governance, informed by an ethic of responsibility--an evolutionary ethic, not merely an environmental ethic--and it requires appropriate ways of thinking about new issues and making decisions. It involves public policy: matters of survival and extinctions are already being legislated everywhere. ... It involves a general recognition, one that will have to be articulated throughout human society, that the human species has developed a specialized role in the global ecosystem...."

More recently, Peter Vitousek, et al., ("Human domination of Earth's ecosystem," Science, 25 July 1997, pp. 494ff) have written what amounts to an exhaustive update on Anderson's position, though they do not cite his work:

"All organisms modify their environment, and humans are no exception. As the human population has grown and the power of technology has expanded, the scope and nature of this modification has changed drastically. Until recently, the term, 'human-dominated ecosystems' would have elicited images of agricultural fields, pastures, or urban landscapes; now it applies with greater or lesser force to all of Earth. Many ecosystems are dominated directly by humanity, and no ecosystem on Earth's surface is free of pervasive human influence.

"This article provides an overview of human effects on Earth's ecosystems. It is not intended as a litany of environmental disasters, though some disastrous situations are described; nor is it intended either to downplay or to celebrate environmental successes, of which there have been many. Rather, we explore how large humanity looms as a presence on the globe--how, even on the grandest scale, most aspects of the structure and functioning of Earth's ecosystems cannot be understood without accounting for the strong, often dominant influence of humanity...."

"The global consequences of human activity are not something to face in the

future--they are with us now. All of these changes are ongoing, and in many cases accelerating; many of them were entrained long before their importance was recognized. Moreover, all of these seemingly disparate phenomena trace to a single cause--the growing scale of human enterprise. The rates, scales, kinds, and combinations of changes occurring now are fundamentally different from those at any other time in history; we are changing Earth more rapidly than we are understanding it. We live on a human-dominated planet--and the momentum of human population growth, together with the imperative of further economic development in most of the world, ensures that our dominance will increase. ...."

"In a very real sense, the world is in our hands--and how we handle it will determine its composition and dynamics, and our fate."

The issue of Science in which the Vitousek article appeared is an exceptionally important for understanding how massively artificiality is replacing nature everywhere, and of the necessity of developing an "evolutionary ethic" which recognizes our unique duty to "govern evolution." [In addition to Vitousek, et al., see, David Malakoff, "Extinction on the high seas," F. Stuart Chapin III, et al., "Biotic control over the functioning of ecosystems," P. A. Matson, et al., "Agricultural intensification and ecosystem properties," Louis Botsford, et al., "The management of fisheries and marine ecosystems," Andy Dobson, "Hopes for the future: Restoration ecology and conservation biology," and Ian Noble & Rodolfo Dirzo, "Forests as human-dominated ecosystems."]

While the magnitude of the current challenge is unprecedented, it would be a mistake to think this is just a recent, or Western, concern or phenomenon. This is a long, historical, ongoing, and global human experience. [William Thomas, et al., Man's role in changing the face of the Earth. University of Chicago Press, 1956, and Billie Lee Turner, ed., The Earth as transformed by human action: global and regional changes in the biosphere over the past 300 years. New York: Cambridge University Press, 1990]. Ample evidence exists that many human communities in the past have destroyed their environments and either vanished or moved on. It is becoming clear that something like the fate of Easter Island (Rapa Nui) (the destruction of habitat beyond its ability to recover and thus for the human inhabitants to survive) also happened on other Pacific Islands [Jared Diamond, "Easter End," Discover, August 1995 and "Paradises Lost," Discover, November 1997]. Vast areas of Asia and the Middle East were reduced to deserts, or engulfed in the sea, as a consequence of human activities many thousand years ago [John Perlin, A forest journey: From Mesopotamia to North America. W.W. Norton, 1989]. Western civilization is not uniquely responsible for the vast areas of Indonesia presently aflame or for the resulting choking smoke. It is not entirely new for China to re-configure a river and construct a gigantic dam which will destroy one of nature's most majestic vistas, Three Gorges. Indeed, if any culture has had millennia of experience with "governing evolution", China may well be it. No other part of the world is as fully altered and managed as China is now, has been for centuries, and must be forever.

While I believe it is clear just from what humanity has done and continues to do to Mother Earth that the Pro-Growth/No-Growth debate is entirely a waste of time which completely misses the point. What is needed now is for humanity to recognize, accept, and enhance its obligation to invent and sustain all aspects of the future. There are many other past, present, and emerging trends and processes which also point in the same direction, one of which is our movement away from "real reality" and towards "virtual reality."

All "reality" is "Virtual Reality"

For example, Jesse Ausubel, "The liberation of the environment" (in Jesse Ausubel and H. Dale Langford, Technological Trajectories and the Human Environment. Washington, DC: National Academy Press, 1997), pp. 10ff) has written:

"[H]igh incomes, great longevity, and large population concentrations have been achieved in every class of population on Earth. We manufacture computers in hot, dry Phoenix and cool, wet Portland. We perform heart surgery in humid Houston and snowy Cleveland. Year round we grow flowers in the Netherlands and vegetables in Belgium. The metro in Budapest runs regardless of the mud that slowed Hungarians for a thousand years. In Berlin and Bangkok we work in climate-controlled office buildings. We have insulated travel, communications, energy generation, food availability, and almost all major social functions from all but the most extreme environmental conditions of temperature and wind, light and dark, moisture, tides, and seasons.

"The Japanese have even moved skiing and sand beaches indoors. In the world's largest indoor ski center, Ski-Dome near Tokyo, the slope extends 490 meters by 100 meters, with a thrilling drop of 80 meters that satisfies the standards of the International Ski Federation for parallel slalom competition. On the South Island of Kyushu, Ocean-Dome encloses 12,000 square meters of sandy beach and an ocean six times the size of an Olympic pool, filled with 13,500 tons of unsalted, chlorinated water kept at a warm 28 degrees C. A wave machine produces surf up to three-and-a-half meters high, enough for professional surfing. Palm trees and shipwrecks provide the context.

"In fact, careful records of human time budgets show that not only New Yorkers and Indians, but also Californians, reputed nature enthusiasts, average only about one-and-a half hours per day outside. Fewer than 5 percent of the population of industrial nations work outdoors. In developing countries, the number is plummeting and should be below 20 percent globally by 2050. As Lee Schipper shows, lifestyles revolve around the household. The achievement of ten thousand years of human history is that we have again become cave-dwellers--with electronic gadgets. ...

"We have liberated ourselves from the environment. Now it is time to liberate the environment itself."

Now, in a sense all "reality" has always only been "virtual." Society is very much a social construction, and not an objective entity which impresses itself the same way on everyone [Peter Berger and Thomas Luckman, The social construction of reality. Doubleday, 1966--and the entire "deconstructionist" "PoMo" field of Foucault et al]. What you think you know about the world, you know almost entirely because of the way it has been constructed for you by your culture--its myths and beliefs, your language, your family, school, religion, and your own personal experiences and memories (often false!) of them.

All cultures tell stories, make up dramas and plays, carve statutes and make other visual images, sing songs, beat drums, blow horns, invent rituals, give explanations for events, and in many other ways embellish the bare "facts" of every simple "real" sensory experience.

However, we recently have become even more extraordinary story tellers because of new technologies which have made story telling even more vivid and multisensory than what was possible in the old days when you could only speak, sing, dance, carve, mold, or paint.

The printing press is what really made the fiction possible. Before that time, very few popular "stories" were ever written down. Some were, of course, but writing was generally preserved for "serious" things like laws, religious documents, economic accounting, and pornography.

But with the printing press, information and disinformation became cheap and abundant, so that not only serious fact and ennobling fiction but also "trashy" novels--be they "bodice busters" or "westerns" or "mysteries" or "science fiction"-- began to flow forth, first as a trickle and then as a flood. And with the subsequent invention of the public school system where everyone has been taught against their will how to read and write, more and more people now read and write whatever they prefer to read or write. While that might be law, religious documents, and scientific tomes for some, it is frivolous fiction for most.

So, more and more people live more and more of their time in more and more fictional places--in a virtual reality derived from reading printed words, and not from the "real" reality of their five senses.

And then, after the printing press and the public school have come the radio, and movies, and television, and board games (like Monopoly) and video games, and computerized simulations like Sim City or MYST, as well as what is currently called "Virtual Reality" with (for the time being) its goggles and gloves, and...eventually the Holodec of the Starship Enterprise.

All of which teaches more of us how to live in many alternative presents, as well as to be prepared for many alternative futures. All of which helps us gain perspective, distance, and perhaps criticism of the "crackpot realism" which rulers, priests, teachers, journalists, and parents may wish to impose on us. We can and do "escape" from the reality of our everyday lives by reading, watching television, playing video games or interacting in role-playing MUDS and MOOs with people we will never meet in person spread out across the world. Indeed, most of us when asked to explain something, will give an example, not from our everyday "real" lives, but from a movie or TV show or game we have experienced. Mediated reality is far more real for most of us than is real reality.

And this will be increasingly so until, as the Chinese philosopher Lao Tse said many, many centuries ago, "I don't know whether I am a man dreaming I am a butterfly, or a butterfly dreaming I am a man."

But there is more.

Artificial Intelligence and Artificial Life

In 1997, after many years of trials and tests, a computer program called "Big Blue" finally defeated the world's chess champion and a new era in Artificial Intelligence seemed to have been born. Since then, other computer programs have been developed which seem able to defeat the very best human intelligence in every game ever invented, including the Japanese game "go" which may be the most complex game of all.

Is human intelligence about to go the way of the dodo--towards extinction, or at least marginalization along side artificial intelligence, perhaps like a dog besides its master?

On the other hand, computers seem unable to do the simplest things--things which a dog would have no trouble at all doing, such as recognizing his master's face, or voice. Or fetching a stick without falling into a hole, walking off a cliff, running into a wall, or bringing back a postman's shoe instead of the stick.

Sending Rover to fetch a stick is still much more reliable than asking Truth Sojourner to visit the Mars rock named Yogi Bear without a mishap.

It turns out that it is much easier to get a computer to surpass humans in "artificial" tasks--like a game which has a finite, if vast, number of choices--than it is to get a computer to do all of the "natural" things that a child learns to do by age three.

In all likelihood, computers will never learn to think and act like humans. And why should they? Humans are actually not very good at thinking. The human brain has evolved very much like the city of Rome has evolved--by layer upon layer of encrusted, often obsolete, forms underlying what is temporarily new, until you reach the surface.

For all its wonderful charm, Rome was not built in a day, and it was not built for the transportation, housing, and commerce of the 20th Century. If we were to start all over again, and devise a city fit for modernity, we might get something else--like Los Angeles, or Las Vegas, cities clearly designed for the car, artificiality, and for abundant leisure time.

What we humans call "rational thought" is just the icing on a very large cake of emotions which is itself overlying a thick bundle of automatic reflexes "we" (our conscious self) are entirely unaware of. Our reflexive and emotional brain is constantly doing things which our rational brain must struggle to "explain" or "control."

Artificial intelligence does not--or at least need not be designed to--have these limitations. It can reckon without emotion or automatic reflexes getting in the way. This may cause a "machine" to do things which strike us as stupid or unappealing, however rational they may actually be. But that is because of our tendencies towards emotionality and is not a defect the machine's rationality.

In any event, even today, much--increasingly most--of the world is being controlled by automatic, artificial (usually electronic) rules and processes which present us with decisions which we often literally must follow without question--our very lives depend on it--or which, when we do try to override, turn out to have been the decision we too would have reached if we had only had the time. Which of course we don't. That is the main point. We increasingly use computers to make decisions for us in situations where it is too dangerous for humans to go, or where it takes humans too long to decide. Given the speed of transport, and especially the speed of light at which all information travels, we increasingly have to leave split second decisions up to machines, just so we humans can survive.

We are also making "smart" everything--smart houses, smart cars, smart birthday cards, smart weapons.

Indeed, the term "artificial intelligence" is itself a swiftly-moving target. It is, as David Miller says, "whatever machines haven't learned to do yet." Prof. Miller says that the intelligence (sensing and decisionmaking ability) currently in your

automobile would have been termed "artificial intelligence" twenty years ago. Now it is not, and "artificial intelligence" is something even smarter--which a machine can not yet do (but soon will).

The British researcher, Ian Pearson, believes that artificial intelligence which surpasses human intelligence lies just around the corner, in the early 21st Century, evolving by the very practical and almost invisible processes just described. Soon, in the mid 21st Century, he believes, humans will realize that they are only one of a myriad of truly intelligent entities on Earth. Some humans will choose to merge with artificial intelligence to form various kinds of cyborgs. Some humans will link artificial intelligence with genetically-engineered beings and then both to human beings and human intelligence. Some humans will insist on staying pure and "natural". And some artificial intelligences might be wise enough to "reject" any contamination from either human or other genetically engineered biosystems, recognizing that biology is just a way-station, if not ultimately a handicap, and that the only good intelligence is bio-free intelligence, electronically linked throughout the globe, over the solar system, and eventually throughout the galaxy.

4. Genetic engineering and the invention of new forms of life

Whatever Artificial Intelligent beings might decide, humans should anticipate that among the most powerful technologies of the 21st Century will be those of genetic engineering. Whatever coal and iron did for the 19th Century, and oil and the electron did for the 20th, the gene will do for the 21st--and much, much more.

It has been said that we presently live in an "information age." Maybe so, but the ultimate information--the code of life--has been cracked, and new forms of life will soon be hatched. We are only beginning to enter the True Information Age of genetic engineering.

However much people and groups may be opposed to genetic engineering, and there are many and often for very good reasons, trying to stop genetic engineering is more like trying to stop abortions or recreational drug use than it is like trying to stop nuclear generating plants.

Genetic engineering is comparatively easy to do "in your kitchen", and is driven by many individuals' desires to "correct" a genetic "defect" in one's self, or one's child, and then to "improve" the genetic characteristics of one's self, or one's child. It is very private, very emotional, extraordinarily powerful.

It is subject to misuse, and it will be misused. But it will be used. While its progress can be slowed and influenced, it cannot be stopped.

And the genes which will be manipulated exist in almost all living organisms--from humans, to other animals, to plants grown for food, to all plants everywhere in the world and under the seas.

Controlling the genes controls a sizable portion of the behavior of an organism. Most certainly genes do not govern all of the behavior, to be sure. The role of the environment in shaping each individual organism, and a species, is enormous. Clearly the interaction between environment and genes is the key to any specific future state of any organism. But controlling genes does give us much more power over the future of the organism than does just controlling the environment alone.

And we have already seen that humans are indeed also controlling more and more aspects of more and more environments everywhere. Genetic engineering will just close the circle already well traced by human domination of the environment.

So it seems clear that with the emergence of genetic engineering over the 21st Century, no previous lifeform--not only humans, but all of life--will be left unmodified, or at least free from the potential of genetic modification. Life itself thus becomes one more artifice--one more responsibility of humans to create and manage.

Nanotechnology: manufacturing on a molecular scale

In 1987, Eric Drexler wrote a book which turned the world on its head, whether the world noticed it or not. Titled, Engines of Creation, it described the potential power of self-replicating machines which could be created on the size of molecules--which are the smallest physical units of elements and compounds--and then set loose to do whatever they were designed to do, free from further human intervention.

Nanotechnology (technology at the scale of one nanometer--the scale of a molecule, and thus also often called "molecular engineering") has been the subject of considerable research, speculation, and hope (with some fears) since then. The Foresight Institute, founded by Drexler, has been at the forefront of much, but certainly not all, of the action.

If nanotechnology proves feasible, all bets are off. The old world of scarcity is over, as are the old ways of producing...everything--food, clothing, automobiles, buildings, yes, everything. The energy requirements of nanotechnologies are insignificant compared to those of contemporary industrial technologies. And since humans won't need to pay much attention to the manufacturing processes, it adds even more reasons to begin thinking seriously about moving towards a peaceful, prosperous, and meaningful world without work.

But my point here is that nanotechnology is one more very important brick in the wall of artificiality. Molecular engineering controls matter at its smallest level allowing the creation of countless "machines" to do countless processes that only nature--or nothing at all--can do now. As the originator of the idea of nanotechnology, the physicist Richard Feynman said in 1959, "there is plenty of room at the bottom." This is grassroots, decentralized, individualized development at its finest and most powerful.

Space settlement and the creation of intelligent life throughout the solar system

Even though the fortunes of the space agencies of all countries rise and fall with rising and falling economic, political, and ideological fads and fashions, on the basis of my continuing experience with the staff and students of the International Space University, headquartered in Strasbourg, France, I am absolutely convinced that over the 21st Century humans will establish permanent settlements on the Moon and Mars, and perhaps also on artificial satellites stabilized at various Lagrange points. It is also likely that over the next century, manned exploratory missions will be sent elsewhere in the solar system, and that unmanned probes will be moving well

beyond the confines of our Sun.

There are many consequences of these probabilities. One is based on the fact that all science is, fundamentally, comparative. As Marshall McLuhan said, "we don't know who discovered water, but we are pretty sure it wasn't a fish." You have to be a fish out of water to discover the importance of anything that is so omnipresent around you. Thus, one of the most important reasons to go to Mars to stay is because we then will be able to develop science which is based on more than just what happens on Earth. And as we move beyond Mars, our data points will increase, and so our knowledge of everything, including ourselves, will change dramatically from what we now, so confidently, think we know.

A few years ago--before the public announcement of the possibility that lifeforms from Mars existed in rocks found in Antarctica--I wrote the following:

"[R]ecent evidence suggests that there may already have been some exchange of lifeforms at least between Earth, Mars and Venus. This happened initially during the early periods of all three planets when they were experiencing heavy bombardment of meteorites. The blasts ejected huge chunks of each planet's surface into space with some of it eventually falling onto the surface of the other two planets.

"Jay Melosh concluded a survey of this phenomenon by observing that 'given the possibility of the exchange of life among the planets by large impacts, we may have to regard the terrestrial planets not as biologically isolated, but rather as a single ecological system with components, like islands in the sea, that occasionally communicate with one another.'   [H. Jay Melosh, "Swapping Rocks: Exchange of surface material among the planets," <u>The Planetary Report,</u> July/August 1994, p. 19, quoted in Jim Dator, "Even though oxygen is flowing, the plastic bag may not inflate," in Tae-Chang Kim and Allen Tough (eds.), <u>Thinking about Future Generations</u>. Kyoto: Institute for the Integrated Study of Future Generations, 1995]

Viewing Venus, Earth, and Mars as part of the same "neighborhood" is an excellent idea. Many years ago, the true father of all space exploration and space philosophy, the Russian Alexander Tsilokovsky, wrote that while Earth is the cradle of humanity, it is time that humans grew up and left their cradle. I am here contending that it is also time we started exploring our neighborhood! When we do, we will feel very different about both ourselves, and our "home."

In what is still one of the most important volumes on space exploration and settlement from a human perspective, Ben Finney and Eric Jones "reiterate that the use of technology to expand beyond Earth would be entirely consonant with the whole trend of human evolution. From the time the most adventuresome of apes left the tropical forest to seek a living in the grasslands of the African savanna, our ancestors have been inventing technology to adapt to new environments and to expand over the globe. There is a large techno-cultural distance between grubbing succulent roots from the soil of the savanna with digging sticks on the one hand and growing algae to provide both food and oxygen for Moon colonies on the other. And it is a long way from sailing canoes to interstellar arks. But ever since our ancestors started using tools to survive and eventually flourish in new environments, the pattern of evolution by cultural as well as biological adaptation has been underway. Although the prospect of traveling and living in space might seem 'unnatural' to many, it would represent a logical extension to the technological path our ancestors have been following for some 5 million years." [In Ben Finney and Eric Jones, eds.,

Interstellar Migration and the Human Experience. University of California Press, 1985, p. 335.]

Humans, a profoundly migratory species, some time ago filled up every available ecological niche on Earth (except the ocean depths), and now are threatening to overpopulate themselves to extinction. Space (much more than under the seas) offers humanity the obvious next evolutionary step.

The point to be contemplated for our discussion here is that our movement into space is just one more step towards complete artificiality. It clearly will be necessary for humans to develop complete self-contained biospheres in which they can safely live in outer space. Oxygen, water, food, perhaps gravity, protection from cosmic rays and solar blasts--everything that we take so much for granted on Earth--will have to be brought to space, or created their, artificially, by humans.

At first, humans in space will probably try to make space as Earthlike as possible, but it is highly likely that Earthkind in space will eventually become Spacekind--no longer defining everything, or even anything, by "what it was like back home on Earth." Thus, as Ben Finney says elsewhere in the book cited above, evolutionary processes long pent up on Earth will be unleashed in space, and the most dramatic explosion of speciation the universe has (apparently) ever seen will occur. This will be greatly aided by advances in genetic and molecular engineering so that a myriad of new intelligent lifeforms we arise or be created as life moves from Earth to the solar system and beyond.

I consider one of the most important reasons for space exploration is to provide humanity with the experience it needs to create viable artificial biospheres here on Earth. Of course, as I say, I suspect that ultimately, intelligent life--artificial life-- will indeed "shed its earthly biological container" and the biosphere in which it was nurtured, and seek other, perhaps silicon, forms.

But, for the foreseeable future, we desperately need a biosphere that works, given what we have done, and continue to do, to the only one we know works, Earth. It will require a lot of human ingenuity to create and maintain a new one, so our experiences in creating biospheres for space will be very valuable to anyone engaged in a similar enterprise on Earth.

Futures studies and the invention of the future.

While every culture, over all time, has largely invented the world in which it lived, inventing the world is a special characteristic of modern societies. One clear example, among many, was what the Founding Fathers of the United States did, first in writing their "Declaration of Independence" so that all the world would understand the reason for their actions, and then establishing a written "Constitution of the United States of America," so that all posterity would be guided by their "constituting" words and deeds.

These two profoundly influential documents were also accompanied by a change in the way "legislators" came to view themselves. Once upon a time, established "men of reason" would come together on occasion to "discover" the law which lay apparent to them in nature (and/or God). But by the end of the 18th Century, legislators were also viewing themselves as 'law makers" and not as mere "law discoverers"--they

came to believe that they could improve on nature's laws by using nature's principles to write laws of their own for the benefit of humanity.

"Law making" has by now become so characteristic of legislatures (and often judiciaries, in the American system) that we think nothing of it. However, the early pretense was that once the legislators had made a new law, the problem was fixed, and there was no longer need for more legislation in the area. That is one reason why legislative assemblies originally met (many still do) for only a few months in the winter (while the crops were in and there was little work to do on the farm). But here, too, gradually, legislators enacted more and more laws, and the creation, modification, interpretation, and administration of law has become a full time occupation for an ever-growing number of people.

This led Donald Campbell some time ago to suggest that, since legislation never finally "solves" any problems, legislators should view themselves as experimenters, and their laws as social experiments: enact a law and see how it works, modifying it as we go along based on what we learn from the operation of the law.

This could become social engineering on a vast scale, so vast that even Donald Campbell retreated from his position, recognizing how terribly intrusive it would be to have so many experimenters measuring and monitoring the effects of their experiments on all the citizens of the world.

Nonetheless, governments are engaged in social engineering, more or less consciously and more or less intrusively. And even if the libertarians were to have their way, and governments do diminish to basically nothing, other social forces-- probably economic--would then move in to fill the political vacuum. So we do live in somebody's or some group's social experiment--currently we live under the myth of the "magic of the marketplace," whether we like it or not.

Now, futurists have noted for the past thirty years or so the increased pace of social change, and the necessity of "looking ahead", of assessing future impacts, of heeding the needs of future generations, before acting in the present. So futures studies itself joins other political and economic theories, practices and institutions which strive to create a world increasingly under human responsibility as well as human control.

Futures studies and all other value-driven actions increase the artificiality of our world.

Conclusion.
        Now, to be sure, none of the factors of artificiality that I have touched on are new. Futurists have also written about them for years. For example, artificiality itself was well discussed by Herbert Simon in his, Sciences of the artificial (MIT Press, 1969). and issues of a new intellectual, biological, and spiritual future for humanity range from the seminal work of P. Teilhard de Chardin, Phenomenon of man (Collins, 1959), though the following works:

Theodosius Dobzhansky, The biological basis of human freedom, Columbia University Press, 1955

Theodosius Dobzhansky, Mankind evolving, Yale, 1962

Rene Dubos, Man adapting. Yale 1965

Daniel S. Halacy, Jr., <u>Cyborg: Evolution of the superman</u>. New York: Harper & Row, 1965

Erich Jantsch, <u>Design for evolution: Self-organization and planning in the life of human systems</u>. G. Braziller, 1975

Erich Jantsch and Conrad H. Waddington, eds., <u>Evolution and consciousness: Human systems in transition</u>. Addison-Wesley, 1976

John Roslansky, ed., <u>Genetics and the future of man</u>. Appleton-Century-Crofts, 1966

Julius Stulman, <u>Evolving mankind's future</u>. Lippincott, 1967

Gordon Rattray Taylor, <u>The biological time bomb</u>. New York: The World Publishing Company, 1968

Gordon Wolstenholme, ed., <u>Man and his future A Ciba Foundation volume.</u> Boston: Little, Brown, 1963.

What may be new now is that ability (the technology) and the need (collapse of the "natural environment") are coming together in age-cohorts and cultures who may be prepared to deal positively and creatively with artificiality.

I was at first distressed when I learned recently that none of my undergraduate students, and few of my graduates, had ever heard of <u>The Limits To Growth</u>. They found the debate fascinating, since they are fully aware of the dangerous environmental future facing them.

But unlike past and present generations--who rather accurately foresaw the 21st Century, and debated the pros and cons of growth--my students will actually LIVE in the 21st Century. And, unlike us, they intend to make the best of it. If that means governing evolution, then so be it. They are more than willing to give it a try!