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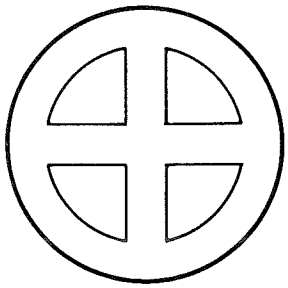
KUHF Radio Interview with Ted Gordon



Lutheran Brotherhood Colloquium on the Church in Future Society

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

LUTHERAN BROTHERHOOD

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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**

Theodore J. Gordon

President, The Futures Group; formerly vice president and senior research fellow, Institute for the Future.

Mr. Gordon founded The Futures Group in 1971. Associated with futures research and policy analysis for many years, he has made both substantive and methodological contributions to both fields. He is noted as one of the innovators of several methods of forecasting, including cross-impact analysis, trend impact analysis and probabilistic system dynamics. Mr. Gordon regularly contributes to research projects, some of which include projects for the Office of Technology Assessment and National Science Foundation. He has also contributed to research on U.S. power needs and power-generating capabilities, forces for change in the insurance industry, perspectives on American social change, life-styles of the future, future computer developments and applications, case studies in institutional innovation, and new business strategies. His consulting work has also included efforts concerned with the design and conduct of corporate and governmental forecasting activities, the development of forecasting capabilities within particular companies, and the social responsibility of business.

Mr. Gordon helped establish the Institute for the Future where he served as Vice President and senior research fellow. There he contributed to studies on the future of employee benefits, computer risk, relationships between business and society, problems of technology assessment, and the development of cross-impact analysis. Before joining the Institute, Mr. Gordon directed major engineering programs at the McDonnell-Douglas Astronautics Company, serving variously over 16 years as chief engineer of the Saturn Program, test conductor for the Thor and Thor-Launch Systems, and director of Advanced Space Systems and Launch Vehicles. He was responsible for defining, executing and supervising the design and conceptual work of Douglas' space station, boost vehicle, and interplanetary programs.

He has served as consultant to many large organizations including Northeast Utilities and the American Council of Life Insurance. He has lectured frequently for the executive programs at Arden House for Columbia University, the Young President's Organization, the Canadian Management Development School, and other academic and industry-related associations. He has also served as Regents Professor at the UCLA Graduate School of Business. Mr. Gordon has published a number of books which include: *First Into Outer Space* with Julian Scheer; *The Future; Ideas in Conflict;* and *Ahead of Time* with Harry Harrison. *A Technology Assessment of Life-Extending Technologies,* with Herbert Gerjuoy, is currently in the process of being published. He has contributed to numerous multi-author books, holds several patents and has authored more than 100 reports at The Futures Group.

KUHF (Houston) Interview with Dr. Theodore J. Gordon

President, The Futures Group, Glastonbury, CT; Former Vice President and Senior Research Fellow, Institute for the Future.

Interviewed at the Lutheran Brotherhood Colloquium on the Church in Future Society, January 29 - February 2, 1979.

INTERVIEWER: I'm Fred Kierstad, associate professor at the University of Houston at Clear Lake City. Today we're fortunate to have with us Dr. Ted Gordon. He is president of The Futures Group in Connecticut. He's done quite a bit of work in forecasting methodologies. He's best known for his research in technological impacts, genetic manipulation, studies in drugs and behavior and in the study of cloning. He's done quite a bit of work as far as writing -- he is co-editor of Ahead of Time and he is also a contributing editor to Olaf Helmer's book Social Technology. He has been vice president of the Institute for the Future and we're very happy to have him here today.

I'm going to ask a few questions about what you think is going to happen to society in the future and what technology might do to us. I think the listening audience might be very happy to hear some of your comments and I know the people down in the futures program where I teach at the University of Houston in Clear Lake City would like to know some of these things. As a matter of fact, some of the questions I might ask you are questions my students would like to know.

Since this conference where you are is the Lutheran Brotherhood Colloquium on the Church in Future Society, I might first ask you a few questions about what you think might happen to the church as far as what technology or what society might do?

GORDON: Tomorrow my remarks won't be directed to religion per se but technology and its impact on society. But to address your question specifically, based on some work we did some years ago, it seems to us that religion as a total enterprise is long-lived. Take a look at three components here. First from the standpoint of religiosity, it strikes us that if that comes from man's relationship to the unknown, to the infinite, that that's not about to disappear or even change in any magnitude in the near term because the infinite is by definition infinite. Even as science progresses and knowledge progresses, all that will serve to do is to once again demonstrate the vastness of that unknowable.

A second component has to do with mystic experience (let's try to capsulate it that way). Here there are some rather significant changes possible, I think, because what technology can bring to experience is really changing in di-

mensions now. You might consider here, for example, the technology of pharmaceuticals and chemical experience, to put it in those terms, or behavior modifications, or any number of psychological techniques. In other words, that second dimension of religion has vast opportunities opening for it in the decades ahead.

But third, dealing now specifically with the organization of the church as a dimension of religion, here the organization is in for the kind of revision that all organizations are undergoing now. It has to do with the internal politics, external politics, the relationship between people and the organization, the ability of the organization to respond to the demands of society, and all of those things that we can ascribe to any organization at any point in time. Here the changes can be very significant. What are people going to demand of their organized religion? What kind of services? What kind of relationships? That's very dynamic and very, very hard to forecast, but certainly in for change.

INTERVIEWER: There have been some writers that have talked about, for example, the machine being close to God because it's exact and objective and immortal. What do you think about that kind of writing, when they talk about the machine getting close to God?

GORDON: You know I heard a very brave person at an American Association for the Advancement of Science meeting three or four years ago establish and defend the position that the computer was the next chain in the evolutionary cycle and that was God's design, and it's only because the computer had wheels, that it was not through natural evolution that such a machine could be produced. I say he had to be brave in front of that cynical audience to back that kind of argument.

No, I rather think that that's not true. We're in the area now of individual judgment and individual perceptions -- there's no absolute here. But it strikes me that the machine is very much the servant still, and will be for some time, of the designer of society. That's not to say, mind you, that artificial intelligence is far off. I think it's here now and will develop in great leaps from this point on. We will have machines that can do things that we call intelligent, smart, and creative instantly. But they will be working for us, at least over the time horizon that we're talking about and to ends that we define.

INTERVIEWER: You know, one of the things that interests me the most about the intelligence when you're speaking about it is, of course, the educational aspect and there are quite

a few people, including yourself, who have talked about intelligence having a little different meaning in the future than it does now, in the sense that people used to think intelligence was how much information you could collect. Whereas intelligence might have a different meaning today, more in a sense of being in the situation where a person can use data, separating the meaning of data and intelligence and saying that intelligence is the ability to be able to use information that you accumulate.

GORDON: I think I would agree with that. It's the ability to take masses of data, masses of statistics, masses of unrelated bits and to process them in a way that is cohesive and germane to the problem. That's not only a human attribute, of course, and it's becoming much more a capability of machines these days to do precisely what we just said.

INTERVIEWER: You know, Albert Rosenfeld a few years ago wrote about morality and he put it in technological sense by saying that maybe morality in the future might be more in a sense of sharing things like intelligence for example. That the morality of the future society might be, in a sense, sharing one's hopes and dreams and a feeling of community, but also in sharing intelligence. It seems that a lot of writers are talking about the future in terms of people getting more together and doing things in a cooperative sense than in a sense of nationalism or even other kinds of ...

GORDON: I don't equate morality with cooperativeness, necessarily. I could imagine societies based on cooperative immorality.

INTERVIEWER: Yes, that's true.

GORDON: It's easy enough to point out societies that have shared goals and those goals are, in our perspective at least, very immoral. So, I would look to other directions for the definition of morality that have to do somehow with more fundamental beliefs.

INTERVIEWER: Yes, there is the question of saying what morality will be. There always will be that question and the problem of saying that morality is a sense of sharing, what kind of sharing is going to have to be determined.

GORDON: But let me go on to say that for a member of that society, irrespective now of other societies looking at it, he is moral if he shares that society's sets of beliefs. It's only through our vantage point looking at that society from the outside that we can call it immoral because we don't share their beliefs.

INTERVIEWER: Let's go on. I have a few other questions -- the things you're going to address tomorrow in this conference -- I'm quite interested in what you think will happen in technology and I'm going to let you speak about specific kinds of technology if you will. I know that everyone listening here would like to know what you foresee as possibilities in technology and how that might influence society.

GORDON: I'm going to talk about four specific technologies tomorrow as really primary drivers of social change -- not exclusive drivers, but nevertheless large determiners of what life will be like. Would you like me to go through them and talk about each one?

INTERVIEWER: Yes, why don't you do that.

GORDON: Well, first I'm going to talk about biomedicine. Here what I mean is that whole family of new techniques that will change life expectancy -- and change it in one of two ways. First by having more people live to an older age without necessarily changing the maximum age to which people live. So what would happen in this kind of image is that people who might have died at 60 now would live to 70 or 75. That's a class of technologies in this biomedical area that we named "curve-squaring" where the curve that we're talking about is a survival curve (the number of people of a given age at various ages who survive -- start with 100,000, by the time they get to 120 nobody is left). What we do with that curve, with this class of technologies, is to square it, make it more rectangular. Those technologies are associated generally with diseases that claim people of middle age today and old age: cardiovascular, cerebrovascular diseases for example, and cancer.

The second class of technology within this biomedical domain has the effect, not of squaring the survival curve, but moving the intersection out to an older age so that the shape may stay roughly the same as it is now but there are some few individuals who can live to a very old age -- 130, 150, 175. That's a very different class of technologies than the first.

INTERVIEWER: But you don't foresee a large group being in this group?

GORDON: No, not immediately but perhaps eventually. That technology, that class, has to do with the treatment of aging as a disease. Aging is considered a disease here and the researchers who are engaged in that kind of field now are trying to find the cause for aging. What is it that

makes cells die? Symptoms of aging are well enough known but the cause for aging is not at all well known and there are many, many different concepts about what causes aging and therefore how one can cure it. Many different scientists with many different ideas can demonstrate laboratory animals that have lived beyond their allotted time as a result of their applying their favorite treatment to those animals.

So, you have these two kinds of technologies within biomedicine. One probable, near term, with immediate effects (that's the curve-squaring type) and one much less certain, much more problematic as to when. But if it happened it would certainly be revolutionary in terms of the way that we live and look at our own life expectancy.

Let's deal, from this point on, only with the more certain one -- that is, the curve-squaring type. That has rather profound effects in the near term but in a dimension that you might not expect. The demographic effects of that, even if we could now square the curve rather suddenly, are not felt to any large extent until a decade and a half from now. The percentage of the population over 65 increases slowly, but the major effect is beyond demography. It has to do with the health and vigor of individuals at a particular age. A 65-year-old is more like a 55-year-old, a 75-year-old is more like a 65-year-old, and so on. The effect of that socially is reflected back to how people live at older middle age and younger advanced age, retirement, inheritance practices, the nuclear family and all of those things that you might expect to follow.

One of the outgrowths of this first technology is a second technology -- I'll encompass that in the general word "nutrition." We reached the conclusion in the work that I'm describing now that nutrition was important to the first class certainly and probably to the second class of technologies. As we pursue what's known about nutrition and its relationship to health and disease, we form the impression that there's a lot yet to be learned. It seems that there are linkages between what we eat and diseases which we experience, but at a later time. There are foods that are poisons -- not in the sense that we eat them today and are dead tomorrow, those have been discovered long ago -- but in the sense that we eat them today and statistically we change the chances of getting a disease some years later as a result of having done that. That kind of linkage between nutrition and disease is a nascent field. Just some hints exist now -- fatty foods are correlated to heart disease, possibly, for example. Certainly smoking is correlated to lung cancer. A lot is to be learned there and in the near term, and that is a very important technology.

INTERVIEWER: One of the questions a lot of people have asked me since I'm supposed to know something about futures as well, is whether taking certain kinds of vitamins, for example, through a pill rather than eating the food really affects them and gives them a better chance of being healthy. Have you done any studies in this area? Because I tend to feel myself that taking a pill rather than eating the food can be healthful but I'm not so sure that in the long run this is necessarily healthful.

GORDON: Well, I certainly can't speak as an expert here but let me just add to the thought before. It's not necessarily so that synthetic foods will be shown to be bad and natural foods will be good because I think we'll find the opposite. There are some synthetic foods that are very good and some natural foods that are very bad.

INTERVIEWER: That might be a surprise to a lot of people.

GORDON: For example, fatty meats may prove to be bad and synthetic vitamin C, to use your vitamin example, may prove to be very good. Vitamin C, for example, has some anti-oxidant properties which some of the aging specialists feel may delay aging. There's a lot to be learned here. I don't think we'll ever have a pill that replaces a good steak dinner no matter what. Furthermore, if we did I wouldn't like it anyhow! There's a certain amount of roughage and a certain amount of volume that has to pass through and while you might get your nutrients in compressed form, I doubt whether the stomach would shrink to the place where it would be as appreciative of a pill as a full meal.

Now the next technology that I will address tomorrow is in electronics. We're in an absolutely fundamental revolution in large-scale integrated circuitry. We can trace it very routinely, very easily from first applications in calculators through later applications in watches, and watch the price drop while the complexity, accuracy and precision have increased. As in almost no other technology, prices have been dropping for components two orders of magnitude a decade while the packing density, the number of components per volume, has been increasing two orders of magnitude a decade also. That capability that's embedded in large-scale integrated circuitry promises to proliferate immediately and give us capabilities for trivial things that are mind-boggling as well as exceedingly important things. Household computers, as you know, are available over the counter. The price is several hundred dollars. We have a small one at home that's an $800 machine that's absolutely fascinating.

Beyond that, machines that can reason, machines that are robots (really robots in the sense that they are adaptive machines able to perform their tasks even though the environment around them is changing from what was anticipated at the time it was programmed), machines that can learn and execute their programmed instructions on the basis of what learning they've acquired in the interim since being programmed. This is where that technology leads us -- to robots, not just robots for the production line, they exist now (their capabilities will be hugely improved with this improvement in electronics), but also for household robots -- programmed vacuum cleaners that can come out of their hole in the wall and clean the floor for you at an appropriate time. This has been written about before but I just saw it for the first time two days ago -- a robot mail delivery cart in the Department of Commerce. I was at a conference and the conference hadn't started yet and I heard something going "bing, bing, bing" in the hall and I looked outside and here's this cart trundling down the hallway. It stops outside the office and rings the bell and the secretary comes out in response to the bell. It's like conditioning: she hears the bell and out she comes to the cart!

INTERVIEWER: The question is, who is being the robot?

GORDON: There's also a machine I've heard about, which I haven't seen, which carries golf clubs. It's an electronic robot caddy for the golfer. The golfer wears a beacon transmitter in his back pocket and the machine follows him. When he stops to hit the ball, the machine stops behind. A fellow who has used one of these machines was telling me about it the other day. He said that it got so that it was his friend. It followed him around the golf course. He was about to go after his ball in the rough and as he stepped off into the rough he turned to the machine and said, "Now you stay there while I go after the ball." That's the kind of thing that we're in for.

The really important consideration here is how such machines replace people on the job. This is very difficult to forecast because of the number of trends that are coming together simultaneously: we have the increasing participation of women in the labor force; as a result of the improved health that I talked about a moment ago, delayed retirement and therefore increasing numbers of older people in the labor force. There's a trend that I haven't talked about yet that impinges here -- the number of people reaching 18 years of age from this year on begins to diminish because that's the peak of the Second World War baby boom now starting to go on the down side. So there is a reduction in

pressures on the labor force from that standpoint and combined with those three trends, now the presence of these automated machines with improved capabilities. How they come together really spells the future of work.

INTERVIEWER: Would you say that, in your studies, people do have a fear of machines -- for example replacing them? Is there still this fear within a population like the United States that their work will be replaced by a robot and they will be out of work? Is there still thinking along these lines?

GORDON: Yes, this is the modern day Luddite argument but it might be right this time. The Luddites were, of course, a movement back at the beginning of the Industrial Revolution where workers revolted against their employers for bringing machines on that did what they were doing in a muscular sense. The argument was that we are being replaced by these machines, what is the role of human beings? The answer, which didn't come suddenly, was that the role for the human being is in the intellectual arena. Now, if what I'm suggesting is true, we're bringing machines aboard that can perform better than human beings in the intellectual area as well and that will give rise to the question again, what is the role for human beings?

INTERVIEWER: So there is definitely an immediate projection, just as the horse might have been projected from the world of work to the world of leisure because of things like the automobile, you really believe that this is going to be one of the major issues for the human being?

GORDON: I think it will be for the near term (let's say the next decade and a half). I don't think the question will be quite as powerfully put as we're discussing it here but rather it will be put in terms of restructuring of work. What does the work place become in the presence of the office in the future, where material can be stored and retrieved with such ease?

INTERVIEWER: One of the questions that I have about work is whether we can define work one way and someone's job in another? For example, Robert Theobald talked about the difference between work and job. Someone might have a job and do that for a living but he might also have work, which he does not necessarily do for a living, as part of his contribution to the society. Do you see some of that as a part of the future?

GORDON: Absolutely, with the transition coming at the age at which first pensions are available. That age has been dropping over time; so has retirement, probably. Now let me define those two terms: age of first pension is clear enough, that's when the company you're working for permits you to stop working and they still pay you through some kind of economic system. But retirement I'm using in a sense that it's the time at which you really leave the labor force. Now I see the trend in age of first pension being toward the down side -- people will be getting their pensions at constant or earlier age. But I see the age of retirement increasing over time for a number of reasons. I talked before about the increased health in middle and older age. There's also good evidence that when people leave the labor force and really retire, they're more prone to die than people who have something to look forward to and feel useful. There are economic reasons as well why people will continue to be in the labor force even though they have a pension. So this age at which people receive their first pension becomes a transition age when you leave your job and go to work in Mr. Theobald's terms. You've now got the money to do what it is you really want to do.

INTERVIEWER: Yes, there has to be that economic base however before some of this can be done. As a matter of fact, he advocates a guaranteed income as part of the proposal and certainly a lot of people look at that a little more drastically than you would other possibilities because of that guaranteed income.

GORDON: Well, look at it this way. In our society, we are affluent enough so that if someone does not have a job he expects to and society to a large extent expects to have him go on welfare. Society supports him -- nobody <u>should</u> die of hunger in our country.

INTERVIEWER: I'm glad you said "should" because some would say that there are situations like that still.

GORDON: So long as we take that now as a given, then the question of income is one of who should pay the worker. Should it be the employer or should it be society? Everybody is going to get paid as long as we're arguing this way, now who should pay? I hear arguments now, increasingly, that this notion that someone has the right to an income either from an employer or from society should lead us to new kinds of thinking with respect to when someone should not have a job anymore. You see, if someone was to get laid off (I'm not advocating this, I don't want anybody to think that I believe this is the best way, I'm just trying to

raise this argument) and goes from the private sector to the public sector as a result for their income, people pay for that anyhow through taxes. If someone who was going to get laid off didn't get laid off but continued to receive his income working at a company that didn't have as much need for him as they did previously, people would still pay for that anyhow but through the price that's set on profits. So there's a real tradeoff here. Which way is better? Which way is more efficient as long as we accept the responsibility that people have to be paid anyhow? I think that's a liberal argument that's being made now and being reasoned through. I don't know which way it's going to turn out.

So these machines have this capability. Have you seen any of these new chess-playing computers? That's an illustration of how fast that technology has come along. It wasn't many years ago when people said that chess playing was one of the hardest things that you could program. Now, of course, there are machines that make is quite easy. I guess the leading edge is a Texas Instruments toy that came on the market this year called Speak-N-Spell. Have you seen that?

INTERVIEWER: Yes. That's really amazing to me. I don't understand how they can do that but I can certainly appreciate the technology involved.

GORDON: We're essentially at the point in that technology when anything that could be done electronically, is possible. It's possible to do it inexpensively if enough units are involved and rather quickly. The design itself is automated now.

INTERVIEWER: It was interesting to me to read an article the other day saying there are some constraints for some of the computers for example, because the constraint is the speed of light. They can do a lot of things now and they're at the point right now where the constraint they have is the speed of light -- the speed of electricity. That, to me, is just mind-boggling because to say that you have that kind of limitation means that there is quite a bit computers still can do.

GORDON: Absolutely and from a size standpoint, the constraint is how small can you make the circuits and still attach wires to the end? So, at least from the size standpoint, the breakthrough comes with nonmechanical connections which are distinctly possible to couple in through RF or couple in through optical means and size compression can even continue. The speed of light seems like an absolute limitation I must say but there are some very, very fast chips now.

INTERVIEWER: We've talked about three of your areas of technology facing society and we have one more to talk about.

GORDON: The fourth one is in the area of genetics. Here I'm speaking specifically about recombinant DNA as the technology which I think will be powerful with respect to its impact on society over the next 10 to 15 years. This is a technology in which scientists are able to identify the specific molecular structure of genes in plants or animals at the nuclear level and to isolate that genetic material in a species and to manipulate it in some way or transplant it from species to species. Decoding the gene if you will, that field has moved with tremendous speed, much greater speed that anybody would have guessed 10 or 15 years ago. It follows, of course, directly from the discoveries of Watson and Crick as to what the DNA molecule really looked like. It's gone so far now that scientists have been able to move genetic material from one species to another in order to create a hybrid animal, if you will, that has not only its original genetic makeup but the gene that has been transplanted to it. From this technology comes a whole host of ideas: at the near term, the possibility of creating organisms that will produce chemicals for human beings. For example, there has already been a set of experiments in which the gene for producing insulin has been moved to bacteria so that the bacteria in their normal metabolic processes organize amino acids to produce an insulin that is usable by humans, or at least the first step in that process.

Microorganisms have been designed to digest petroleum, for example. I understand that in a rather landmark case General Electric has patented a microorganism that will clean up spills. We can imagine microorganisms processing tailings from mine operations to concentrate ore. We can imagine them acting catalytically in chemical processes, almost as catalysts. Enzymes, of course, are used that way today. But I'm talking not just about enzymes but organisms themselves that participate metabolically in reactions. In other words, there's a new chemistry that comes from this technology and rather soon.

Perhaps slightly further downstream, but not much, is the possibility of creating plants other than the legume family that can be self-fertilizing by fixing nitrogen from the atmosphere with microorganisms in the soil that use nitrogen in their metabolism through the symbiotic process. Legumes, of course, self-fertilize that way today. Can the genetic trait from the legume family be transferred to wheat or corn or soy and thus have this same phenomenon occur? It

would be tremendously important, of course, if such could be done because it would mean that increasing amounts of application of nitrogenous fertilizer to improve agricultural productivity would no longer be necessary in the way that it is today. The plants themselves would be self-fertilizing.

INTERVIEWER: You wouldn't have to use the oil resources to make the fertilizer, which is certainly one of our problems in the near future.

GORDON: Yes, or natural gas for the nitrogenous fertilizer. So that could be enormously important. Beyond that, of course, you can let you mind just go wide open. There are certain human diseases that are known to be of genetic origin -- like PKU, mongolism, sickle cell anemia as examples -- will we be able to manipulate those diseases or to treat those diseases at a genetic level? If we could we would. It's just an extension of the current medical ethic. But once we started that then our intervention in evolution has been direct. It's already there indirectly, but that's a direct intervention and of course then the degree that we intervene depends on what we call a disease. Stature, skin color, hair color -- what is it that we want? What is it that we want to become? That is the question.

INTERVIEWER: It's interesting that you mention agriculture because one of the questions that's coming up about the United States of course is the problem we have of our deficit spending and also our trade problem, in that we import more than we export. America is beginning to be considered a food basket and people are talking about political use of food. What work at your Futures Group have you done in those areas?

GORDON: We've done thinking about this, of course, because of its enormous importance. The U.S. is exceedingly productive in agriculture. We produce all we eat, or store, or export with less than 5% of our labor force, so it's very capital-intensive and a very productive enterprise for us. I think between ourselves and Canada, we export more grain on the world market, our concentration is tighter than OPEC's concentration is with respect to petroleum. That's not to say that very much of the food consumed is in international trade. I think the amount is about 10% or so. But that which is traded is highly concentrated as exports from the U.S. and Canada. That means that, particularly in the time of bad harvests, people will come to depend on it. People do depend on it now. That grain is sold, it is not given away. There is a give-away program (PL480) but that

has political strings attached to it even now. Most of the grain that is exported is sold and it's sold on the market to the people who can afford to pay for it, who generally are not the countries that have had bad harvests or are poor. By putting grain in the international market for sale, you do not necessarily solve the problem of starvation. Therefore, what we're talking about fundamentally is a problem of distribution within an economic system that exists. My own fear for this problem is that the market system is not well tuned to the solution of the broader problem.

Let me make that case even stronger. We can look around and see technologies of the sort that I talked about before -- self-fertilizing plants for example -- that would increase productivity greatly. There are many others: domestication of fish in the broad ocean area for example, inland fish farming, biomass in the oceans, conversion of cellulosic material by microorganisms to sugars or alcohols. There are a lot of techniques that are available for increasing world food supply. But by and large, those techniques are expensive and the people who need the food are poor. So that the market system cannot be counted on, in my judgment, to automatically bring those techniques into being. Furthermore, the countries that need the food have labor-intensive agricultural systems rather than capital-intensive agricultural systems, so it's not just simply a matter of our exporting our technology everywhere. It won't work everywhere. It can't be absorbed, it can't be paid for, it can't be introduced simply. So it's a very, very tough set of issues. Should the U.S. (I'm going to rephrase your question because the way I rephrase it will be easier for me to answer, with your permission) take the position of being farmer to the world, growing the food and giving it away politically? No, that can only cause enormous problems for us later on. There will come a time when we're not able to do that either, as long as population growth continues at a rate of 1.8% a year (or something like that -- much higher of course for some countries). Inevitably, we will find it difficult to meet demand, particularly when our supply is dependent on factors over which we have no control, such as weather, climate and so on. There have to be other solutions.

INTERVIEWER: One of the things I think my students would like to know, and I'm sure the listening audience would like to know, some of your work done in cloning for example, the problems of bio-ethics in general, specifically when you were talking about some of the genetic manipulation, what would really happen if we were able to clone a person? How would that affect the society?

GORDON: Let me just say that any work we've done in cloning has really been incidental to other studies. We've never really focused on this as a particular enterprise. Cloning is a process that is unexceptional today in many laboratories at the cellular level. It is standard operating procedure to clone cells and to work with colonies of cloned cells. So what we're talking about here is not cloning per se, it's clear that that has been done and is done routinely, what we're talking about is cloning an individual, cloning a person, cloning an entire organism. Even here, clones of some very complex organisms have been made, frogs for example, already. But whether or not it will be possible to clone an individual, a human being, is problematic at this point. I would guess that such a thing could be done if there were any reason to do it and my guess is that there probably will be reason to do it. The important thing here is the ability to clone illustrates that every cell, irrespective of its function in the body, has all of the information in it necessary to build another entire organism. With that as a starting fact, it means that the technology of cloning at the organism level also leads to the possibility of understanding the generating process at the cellular level. Can we grow self-compatible parts, for example? If every cell has in it all the information needed to create another complete organism, then by "turning it on" you could perhaps make it grow compatible parts. You don't need your whole self to be reproduced, just reproduce something that's wearing out. That's really far-fetched. Nevertheless, that's the kind of thing that's suggested here. So it's not just the ethics of making twins of yourself, it's also the ethics of making spare parts for yourself that are compatible.

What we're talking about ultimately here is a kind of immortality, either by passing your genetic self on to progeny through the twinning process or by allowing yourself to last for much longer periods of time by building your own spare parts. As far as I see, immortality is still a very attractive goal. People still name their sons junior and that's a kind of primitive mirror of what I'm talking about here.

INTERVIEWER: One of the things that I'm quite familiar with in your work is some of the studies you did with various people. You've done quite a bit of work in Delphi and you've done a lot of cross-impact matrix studies. If you were going to advise a person who is interested in studies of the future, what kinds of materials, what kinds of things would you recommend them to do?

GORDON: You mean as background preparation for careers?

INTERVIEWER: Yes.

GORDON: Generally people who work on our staff have some particular specialty -- economics, political science, international affairs, as examples. They are very good at that specialty. They are also a group of people who are generalists and are able to cross disciplinary lines, able to take information, as we were talking about before, from one field and move to another with the ability to make it fit, to draw from one to make conclusions in another. It's something that's very difficult to teach, I suspect, but what I'm talking about here is cross-impact, how these skills lead to those kinds of capabilities. Be good in one field and excellent in one field, but also be able to generalize.

INTERVIEWER: I think a lot people have a misconception about futures studies. They think it is a discipline in itself, when in essence it's really very much interdisciplinary in its approach. To find someone who is capable of being a generalist in the sense of what is needed for the society is going to be a difficult thing to do for everyone, for sure. In other words, you would say that if a person were going to prepare career-wise, that person would have to have a specialty, for example, go to the university, have various specializations, but also to look at how that would impact other sides of what is known.

GORDON: Exactly, but I would also add one other thing now, in hearing you describe it. I'd say that the person who wants to get into the field of futures research should be sensitive to things that we find very difficult to verbalize here -- that is the underlying value sets with which he operates. He's not going to be a person who decides what's right and what's wrong and if he ever gets into a position in which he's pretending to do that, then it's a very dangerous thing that he's doing. Rather he or she should understand that they are not the ones to be making judgments that have value implications here, but are the ones that should be able to point out systematically if they can what the consequences of certain moves are, certain decisions are and to let broader society, however it's constituted, make the value judgments that they can only begin to hint at.