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GLOBAL MODELLING REVISITED

Jay W. Forrester

Reasons for the great impact of *World Dynamics* and *Limits to Growth* include their addressing the correct audience (the public), and the ability of systems dynamics clearly to handle and communicate information on complex and often little understood areas. Modelling projects should usually be global or national (not regional), draw heavily on mental and not just written and numerical databases, and have time horizons of perhaps 100 years. Sadly, critics of Worlds 2 and 3 have yet to come to grips with the fundamental messages presented there, although these messages are becoming increasingly vital.

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TEN YEARS AGO, *World Dynamics* was published,^{1,2} followed by *The Limits to Growth*^{3,4,5} and then by many other projects. I have been asked to comment on the intervening ten years, on future directions for world modelling, and on the relationship to world modelling work at the Massachusetts Institute of Technology in modelling national economic behaviour.

Many people perceive that we at MIT have abandoned world modelling. Instead, I believe a better understanding of national economic behaviour is a logical and productive next step after examining the broad implications of growth of population and industrialization at the aggregate world level.

After the completion of *World Dynamics* and *The Limits to Growth*, I was convinced that the world problematique, to use the Club of Rome phrase, could not be dealt with at the world level as such. There is no world authority capable of solving the world problems. There is no reason to believe that a single solution to the issues raised by world modelling should be imposed uniformly on every region and country. The only feasible way of dealing with the threats arising from continued growth in a limited space is to arrive at national policies that solve the problems locally, in ways compatible at the aggregate world level.

There has been a trend toward disaggregation of world models into regions. Personally, I am doubtful about such regionalization. Are there persuasive arguments for why the difficulties arising from growth depend, either for their

Jay W. Forrester, creator of the first world model, is Germeshausen Professor at the Sloan School of Management, Massachusetts Institute of Technology, Cambridge, MA 02139, USA. This is an edited version of a Special Lecture given at the IIASA global modelling conference, Laxenburg, Austria, in September 1981.

cause or their solution, on the interactions between regions? I suggest that the problems arising from growth in the world as a whole are primarily the problems arising from population and industrialization in countries individually. Furthermore, it is only at the national level that we will have sufficient public consensus and the possibility of sufficiently strong government to deal with the issues raised ten years ago in *World Dynamics*. The issues central to world modelling are also of primary importance to long-term changes at the national level.

Observed past trends in the process of industrialization are accepted by many as reliable guides to the future. But past trends are apt to reverse as nations now move through the transition years that separate exponential growth of the past from equilibrium-seeking behaviour in the future. For example, one study suggests that the end of industrial growth will be accompanied by a decline in the standard of living and a reversal of labour movement with a flow of people away from manufacturing and services and back into agriculture.⁶

If one ventures into models more complicated than those in *World Dynamics* and *Limits to Growth*, I believe the added complexity should not be used to replicate geographical areas. Instead, a more elaborate model should represent additional modes of behaviour beyond the simple life cycle of growth that was the focus of the initial global studies.

The life cycle of growth is only one of the dynamic modes in modern economic systems, although it is the important mode that relates population growth to the fixed dimensions of the world. But there are shorter-term dynamic modes that attract more public and political attention. Unless the shorter modes are also dealt with, explained, and related, I doubt that we can achieve the public understanding of social and economic change that is necessary for a timely dealing with the threats arising from excessive growth.

Two dynamic modes seem especially important. First is the economic long wave, also called the Kondratieff cycle. Second is the ordinary short-term business cycle. These two are important for quite different reasons. They are important even if one is primarily interested in the much longer-term life cycle of growth.

The economic long wave refers to the rise and fall of economic activity over an interval of some 45 to 60 years. I believe that the long wave accounts for the great depressions of the 1830s, 1890s, and 1930s, and that the long wave arises from internal economic processes that cause discontinuities at 45–60 year intervals.

The present stresses in most industrial economies are consistent with the end of the expansion phase of an economic long wave. The long wave is a massive process of overbuilding capital plant during a capital-construction boom, followed by wearing out and depreciating that capital plant in the depression periods when very little new construction takes place. At the end of the capital-construction phase, one should expect that business-cycle activity becomes more severe, unemployment rises, return on investment declines, productivity falters, new innovation diminishes, speculative activity increases, prices and interest rates rise, and economies stagnate. These symptoms, which are consistent with the end of the expansion phase in a long wave, reflect the

economic difficulties now being experienced by most industrial countries.

The economic long wave is important because its symptoms are easily confused with the symptoms of the end of the life cycle of growth. Exponential growth can continue for several hundred years before reaching the point half-way to the ultimate world limit. One more doubling after the half-way point brings nations abruptly to the limit. The last doubling in the life cycle of growth probably will occur during the next 50 years – which is also the periodicity of the economic long wave. Unless the economic long wave and the life cycle of growth are understood both separately and in combination, it will not be possible to interpret properly the changes in standard of living, unemployment, and social and economic stresses that are arising separately from each mode but are appearing superimposed in the symptoms of economic change.

Short-term economic business cycles must also be established in their proper relationship to world modelling. Although business cycles are a comparatively small disturbance of little long-term consequence, they are important because they attract an unjustified amount of attention from both politicians and economists. Furthermore, most methods of statistical analysis tend to emphasize short-term correlations such as are generated by business cycles, and obscure the more important and longer-term modes of behaviour, like the long wave and the life cycle of growth. As one example, the Great Depression of the 1930s is most often described as simply an unusually severe business-cycle downturn; this interpretation denies the independent existence of the much more important economic long wave. Again, so much political attention is given to fluctuations of the business cycle that there is little time left in political debate for questions arising from growth and equilibrium.

If the issues raised in *World Dynamics* are to be understood, the life cycle of growth and the economic long wave must be separately distinguished so that symptoms and actions related to one do not confuse the other. Furthermore, the business cycle must be better understood so that it can be appropriately subordinated to the two far more important and longer-term modes arising from the long wave and from growth.

I wish to return to these issues in due course, and to briefly describe our Systems Dynamics National Model. But first let me give you my reactions to the past ten years of global modelling. These reactions are one of the forces that helped to shape our present national model.

Responses to “World Dynamics”

The appearance of *World Dynamics* in 1971 initiated a vigorous debate that intensified after the appearance of *Limits to Growth* in 1972. In retrospect, I am disappointed by the nature of the criticisms. Most criticisms addressed issues of little importance to the main messages of the books. The big questions still remain unresolved and almost undebated.

The first issue raised in *World Dynamics* is the fact that exponential growth of population and industrialization cannot continue forever. No one who examines the arithmetic of exponential growth will contend otherwise. But admitting that it must stop has not led in turn to a meaningful debate about when growth should stop, or about the means by which it will be stopped.

Instead, the tendency has been to deny the immediate significance of how growth is producing hunger, energy shortage, increasing threats from pollution, water shortages, and social stresses. By denying the inevitability of the end of growth, individuals and governments continue to take actions that will make the future ever more difficult.

Second, the two books emphasized the existence of layers of limits to growth. There is a succession of limits. If one limit can be evaded, another will immediately be revealed. Critics have debated detailed facts about particular physical limits, even as new limits have been thrust in succession onto the front pages of the newspapers. The oil shortage reached public awareness soon after appearance of the books. Now, some people are beginning to realize that water shortage will probably be more serious than energy shortage. But it is not necessary to debate how many of these successive limits there are, or to incorporate all of them into world models, unless one is prepared to demonstrate that the limits are few in number and that all are surmountable so that exponential growth can continue unabated. If indeed there is an unending succession of limits, then world modelling can deal with the concept of a succession of limits without having to represent all such limits.

Third, I am surprised that the final computer run in Chapter 6 of *World Dynamics*, showing an equilibrium with a high quality of life, has never been seriously debated or even attacked. Perhaps the policies leading to that computer run are so radical that they are unacceptable not only for political action but even for discussion. In that computer run, there is a major reduction in the use of natural resources, requiring a modified lifestyle. Although the assumed reduction in pollution generation has been recognized in the past ten years as a substantial issue, effective action has not yet been taken. The lower birth rate called for in Figure 6.7 is accepted as desirable by many people, but only a few governments have made reduced birth rates a major national objective.

The other two policy changes in that run have not only been ignored, but in fact have been aggressively pushed in the opposite direction. The run suggests a slowdown in capital investment and less emphasis on increasing food production. These two should be intensely debated. Why do they work? Are they necessary? If they are not to be pursued, what forces for slowing growth will be substituted for them? Is it true that, with less industrialization and less food production, the quality of life would be higher? I am not positive about the answers but, until demonstrated otherwise, I still have sufficient confidence in the processes represented in the *World Dynamics* model to suggest that these questions deserve serious attention.

It seems clear that the world problematique is becoming more severe as the world creates more industrialization and greater agricultural output. Is it possible that the very things being done to solve problems are in fact the source of these problems? I believe the answer is yes. It is agriculture and public health and better medicine that have made population growth possible. It is population growth that will lead to social stress and atomic war. Nuclear war will terminate growth, but is that the solution we want?

The central issue raised by *World Dynamics* is how growth is to be first controlled, and then stopped. Will the limits be of our own choosing, or will they

be imposed on us by nature or by the breakdown in our social systems? *World Dynamics* was often criticized as a replay of the theme presented by Thomas Malthus, a theme that is often dismissed as having been proven wrong. *World Dynamics* does treat the same theme as did Malthus. But it is not true that Malthus was wrong.⁷ Malthus's major writings are carefully constructed and well documented; and the Malthus arguments were true when he made them, at all times since, and today. Population does tend to run near the limit of the capacity of the earth for any degree of technological advance. Technical advances have not banished hunger or war. Instead, technical advances have only supported larger populations to be subjected to hunger and war.

Impact of "World Dynamics"

As background for this paper, I found helpful the two articles on "Global Modelling" by John Richardson that appeared in *Futures*.⁸ They provide an excellent summary of the past ten years of work in the field. In those articles, Richardson made several comments that are useful as a basis for my discussion.

Richardson argued that the *World Dynamics/Limits to Growth* models had more impact than all the other models put together, although system dynamics has not retained the methodological dominance that might have been expected; traditional economic approaches have become common, so that:

the later global models have more narrowly defined boundaries, a less inclusive set of variables, and a shorter time horizon. . .the perspective of the economist is strongly constrained by the availability of data. . . Certain issues, raised by the problematique of the Club of Rome tend to be excluded either because they are deemed irrelevant or impossible to address.

World Dynamics and *Limits to Growth* were discussed in the business press, newspaper editorials, academic symposia, the environmental and zero population growth publications, and the anti-establishment underground student press. When the books reached the public, they were debated in schools, in parent-teacher associations, and at meetings of the League of Women Voters. Copies of *Limits* were distributed to all salaried employees by the chief executives of several corporations. The books were the subject of television documentaries presented in prime evening time. *Limits* has been translated into some 30 languages and has sold about three million copies.

Perhaps it would be useful for me to comment on the reasons I see for the substantial impact of the two books.

- *World Dynamics* and *Limits* addressed the proper audience – the public, not merely 'policy makers', not the financial supporter, and not academe.
- The time horizon was appropriate; it needs to be the 100 years during which pressures will increase, issues will be resolved, population growth can be stopped, and mankind can be brought into balance with the environment.
- *World Dynamics* dealt with the most appropriate level of aggregation. Dis-aggregation by regions does not give sufficient additional insight to justify the complication.
- *World Dynamics* emphasized policy choices and how different policies affect the future. The trend has since been toward predicting the future rather than

- evaluating alternative policies.
- *World Dynamics* and *Limits* represent population as endogenous variables, internal to the world system. Population is the central driving force toward exceeding the world's carrying capacity. Unless population is an internal variable, a model will not deal with the essential policy issues in the world problematique.
 - *World Dynamics* was undertaken with a willingness to be realistic about the big issues and with the courage to express controversial judgments. The future of the world is inherently controversial, and to avoid controversy is to avoid the important and difficult questions.
 - *World Dynamics* drew on the appropriate database. That database lies in political perceptions and in people's knowledge and observations. The measured numerical database is too restricted to support effective world modelling.
 - *World Dynamics* and *Limits* were based on a modelling methodology that is especially well suited to the task.

Future directions for world modelling

In his papers, Richardson raised several doubts about the present directions of world modelling. I agree with him that the unresolved issues in world modelling include the proper audience for the results and whether to treat the world in its entirety or by regions or by countries (with a bearing on how general or specific the results may be), the time horizon for influential studies of growth and limits (some effects needing more than the 2 or 3 decades before 2000 if they are to appear), the treatment of population (which cannot be independent of other variables), and the ethical considerations in the relationships between nations. It appears that world modelling can choose more fruitful directions than are now being followed.

Let me take these issues in turn.

World, region, or nation?

An effective model should show how policies affect future consequences; it should demonstrate the relative advantages of different policies. But policies are of interest primarily to those who can choose between policies, and who have a self-interest in the outcome. Therefore, modelling should be organized to fit the separate social institutions within which different kinds of policies are to be implemented.

I believe that international politics, the United Nations, recent work of the Club of Rome, and world modelling are all less effective than they could be if they were to clarify the roles of the various institutions for implementing the hierarchy of policies. At the world level, we should focus on those policies that can be implemented only on a world-wide basis. Policies involving actions within countries would best be left to nations.

I do not see that either world government or cooperation between nations is likely to solve the world problematique. Waiting for an international resolution of the pressures arising from growth will be counterproductive. It will only delay action. Instead, at the world level, we should establish the framework

within which nations can individually solve the problems associated with growth.

I see the role for world policy-making as establishing the restrictions within which nations take action. At the world level, we should not try to solve the problems but should only prohibit those actions that would transfer the problems of one nation onto another. This is the question of externalities. It is the matter of dealing with the "tragedy of the commons", to use the phrase popularized by Garrett Hardin.⁹

How do we keep one nation from increasing production by dumping pollution into the atmosphere or ocean so that it hurts other nations? What are the ethical basis and the means of enforcement to prevent a nation that has allowed its population to grow excessively from transferring people by force or infiltration into a neighbour's territory where they will usurp the advantages which the neighbour gained from having limited its own population? How do we stop one nation from using military force or economic pressure to take resources from others?

These negative policies for preventing one nation from harming another will not by themselves solve the problems of growth. Instead, they would establish the structure within which individual countries would have an incentive to solve their own problems arising from growth. Those incentives will be effective only if the advantages of reaching a satisfactory equilibrium can be retained and enjoyed by those who handle the issues wisely. Multiple solutions achieved within a framework that prevents harm to others would lead to solving the growth problems of the world as a whole.

Within the regional debate, world modelling has been used to promote the idea that coping with growth must lead to more interdependence among nations. It has been suggested in the North-South discussions that the gap between rich and poor should be closed by redistribution of wealth. I believe that realistic modelling of these difficult issues would reveal major fallacies in current thinking.

For the poor countries, careful modelling of social and economic factors is likely to show that financial help will do no more than sustain population growth, while the countries become even more out of balance with their future capabilities. For the developed countries, a modelling of their futures may show declining capacity for providing foreign aid.

Developed countries are already pressing against their own growth limits. As standards of living level out or even fall developed countries will be less inclined than now to share with others. If, as our work at MIT with the Systems Dynamics National Model suggests, the developed countries are now at the end of the expansion phase of the current economic long wave (see below), then their economies face a 10 or 15 year period of readjustment, during which they will be preoccupied with their own economic difficulties. At the same time, developing countries will be defaulting on bank loans and expropriating the assets of multinational corporations. Such economic dislocations will reduce international cooperation. The safest and most promising route is for each country separately to reach its own balance between population, geographical capacity, and standard of living.

Any country can support some population at a satisfactory standard of living.

The basic challenge now facing nearly all nations is to establish a balance between population and quality of life. The greater the population, the less will be the physical standard of living and the greater will be social stresses.

The greatest future sources of world instability will arise from changes now taking place within nations. For example, countries now exporting oil and resources are building industrial economies on a depleting resource base. Within a few decades, they will be committed to economies that cannot be sustained when the resource base is exhausted. Some of the most advanced countries may have the greatest future difficulty; Japan may be the most vulnerable country in the world. What will happen in Japan when it no longer has available foreign energy, foreign resources, and foreign markets? All are beginning to disappear, and the trend is most likely to accelerate in the next 20 years.

We need models for understanding national development in the world context.

Population

Many recent world models, by letting population be exogenous (ie outside the world system), lose feedback from other variables back to population, and thus leave out the central dynamic factor driving world growth. The essence of world modelling is to find the high-leverage policies that will stabilize population in time to retain a satisfactory quality of life.

Of course, much debate surrounds the processes of demographic behaviour. But uncertainty about data and policies should not be an argument for leaving out the most important variable in the world problematique. In fact, lack of data is a reason to include population in a dynamic model; assumptions can be tested, and the model used to consolidate available knowledge. The model can become a guide to how available data should be interpreted. As an example, *World Dynamics* was criticized because net birth rate (births minus deaths) rises as material standard of living rises. This assumption was asserted to be contrary to observations of the demographic transition. In our *Policy Sciences* paper,¹⁰ we showed the *World Dynamics* model adapted to the land area and pollution characteristics of the USA. Without any change in the demographic assumptions, the model behaved very like the USA birth rate for the past 100 years. In spite of the assumptions in the model about material standard of living, other factors (including crowding and pollution) yielded a total system with reasonable behaviour. From this demonstration, in which behaviour is correct but detailed model assumptions differ from common interpretations of data, one should conclude that correlations in the social science data ought to be used with much greater caution. Many people overlook the fact that an observed coincidence of two variables does not demonstrate that one causes the other.

If population is put back as an internal dynamic variable in world models, more study will then be addressed to demographic change and to the underlying force that is threatening to drive the world into physical and social limits.

Time horizons

Several world models have adopted a short time horizon; this is dangerous – looking at only the early part of a long process is often misleading. In almost all

systems, a policy change that is favourable in the short run is apt to be unfavourable in the long run.¹¹ Policies favourable to the short horizon are likely to make matters worse beyond the time to which a short-term model applies. The world problematique extends for the next 100 years; today's policies will not mature into their full consequences in less than several decades. The task is not to predict the future with precision, but to choose policies that lead to a better future. To reliably evaluate policies, the time horizon should include that future towards which we are working.

Data

It is customary to lament the shortage of information on which to base models. Social science projects always seem to want more data. The scope and usefulness of models are often limited because of the belief that necessary information is lacking.

I believe sufficient information is almost always available. The presumed data shortage is self-imposed by modellers; either they choose methods that are unable to accept the most useful information, or they fail to recognize where to find the information they should be using.

In looking at available information, start with the dictionary definition of data: something that is given from being experientially encountered. . . material serving as a basis for discussion, inference, or determination of policy. . . detailed information of any kind. There is no hint that data are restricted to numerical information. Modelling can draw on three categories of information – the mental database, the written database, and the numerical database.¹²

The numerical database is restricted in content and narrow in scope; it tells little about structure of systems or about policies, ie about why actions were taken.

The written database is perhaps a million times more informative about plans, organization, and motivations than the numerical database; it is a distillation from the mental database.

But the mental database is the richest, and contains perhaps by another factor of a million more information than the written database. Modellers tend to retreat into the security of numbers taken from the numerical database and ignore the wealth of information in the newspapers, business press, and people's experiences.

The mental database is a rich store of information about structure and policies, the major components of an effective dynamic model. World modelling should be bolder in drawing on all available information. The world problematique is so difficult that the effort should not be handicapped by being cut off from the richest sources of information.

Timeliness

If modelling is to be influential, the work must be done neither too early nor too late. Had *World Dynamics* and *Limits* appeared 20 years earlier, the concern would have been premature, and the books probably would have disappeared unnoticed. In fact, all of the major issues discussed in those two books had been identified for 100 years with little effect on public thinking. But ten years ago

was a critical time. The public at all levels – in the street, in corporations, and in governments – was becoming disturbed about these issues. If the books were appearing for the first time now, they would still have been too late to be influential. The issues would already have come under debate because of the pressures from energy, water, pollution, and social stress. World modelling cannot succeed if it deals only with the issues of ten years ago. It must identify the new timely subsequent issues needed by the public for going beyond the earlier debates.

System dynamics in world modelling

System dynamics was the underlying methodology used for *World Dynamics* and *Limits*. The books could not have had the influence they did except for the viewpoint, information inputs, and communications clarity made possible by system dynamics. Most world modelling projects have now adopted other methodologies but are encountering barriers that system dynamics might help to overcome.

Perhaps it is time to reintroduce system dynamics into world modelling; it lends itself to communicating with the public, dealing with long time horizons, choosing the appropriate level of aggregation, emphasizing policy choices, making all the variables endogenous, joining the arena of political controversy, and drawing on the rich and diversified mental database.¹⁴⁻²¹ System dynamics can accept nonlinearities. It can incorporate structures known to exist and whose behaviour will be important in the future, but whose influence has not yet become strong enough to be manifested in available quantitative data.

If world modelling is to be effective, the methodology used must be capable of accepting the database that lies within public thought and apprehensions. It must establish a model structure that conforms to the perceived structure of the real world. It must be capable of showing how society has arrived at the present difficulties, as well as how to emerge into a better situation. It must deliver clarity and consistency to replace confusion and contradiction.

I believe that *World Dynamics* and *Limits* achieved their impact because the underlying system dynamics methodology is capable of providing two-way communication from public concerns to modelling, and back to moulding public opinion.

A system dynamics model can be used to achieve consistency where there has been inconsistency. Consider first the internal consistency within the model framework itself. The good modeller can discuss the issues surrounding his subject without contradicting himself. Such lack of internal contradiction is a goal that no public official can achieve based on a liberal arts education, and intuition. The modeller can know exactly the assumptions he has made. Without a shadow of a doubt, he can determine the dynamic consequences that follow from those assumptions. He can demonstrate with certainty the dynamic changes that will occur in his model as a consequence of policy changes in that model. Within the modelling realm, he can maintain complete internal consistency.

Internal consistency is not enough to be persuasive; there may be insufficient agreement with the real world. The impact of *World Dynamics* rested not only on internal consistency, but also on consistency between the message and the prior

knowledge of the reader. The model had a high degree of validity for the average reader; he could recognize the model structures in real life. The assumptions are plausible. The behaviour is reasonable, explainable, and understandable. Policy changes can be understood in terms of their future implications, and can be related to the real world.

With internal consistency among assumptions, behaviour, and the effects of policy changes, along with external consistency with the reader's prior knowledge, a system dynamics model can become a powerful basis for communication. The communication can be structured around the model and its behaviour (as in *World Dynamics*), or be a descriptive argument, without reference to a model, while retaining the consistency of presentation that can be drawn from the model environment.

World modeller and the audience

The ultimate impact of world modelling depends on the roles assumed for the many participants in the process. How does the modeller see himself? What audience does he address?

Many people limit the effectiveness of their modelling work by assuming a role that will necessarily lead to little change in world and national thought.

There are two attitudes, common in the social sciences, with which I disagree – that 'policy makers' constitute the audience for global modelling, and that the modeller occupies a role apart from other groups in society. 'Policy makers' often refers to people in government. For the great issues considered in world modelling, the present people in governments are of little consequence. They do not have the power to reverse long-standing traditions. They will not be in office long enough to deal with these issues.

To suggest that the world modeller fills a role separate from policy makers and the public implies that the modeller is an advisor and that he is subordinate to people of greater power. As a consequence, the world modeller becomes diffident and avoids controversy, subordinating his better judgment to the short-term wishes of his financial supporters, rather than finding financing that will permit realistic work. He fails to act as if he believed himself the guardian of the future for himself, his children, and his world.

The audience must be the public in general. In today's social structures, only in the role of a private citizen does a person take a long-range view of the future. I believe most individuals do have a view of the future extending through their own lifetimes and probably through that of their children. An individual in the context of a corporate or governmental position is apt to be limited to the duration of his expected tenure in the position. World modelling deals with the long term. The public is the only effective audience.

World modelling should deal with the big issues and with the most controversial subjects. Otherwise, what is its justification? If the results of modelling are limited to recommendations that are uncontroversial, it follows that the recommended actions are already being taken and no influence from world modelling is necessary.

Government officials are not the appropriate audience for highly controversial recommendations. All governments, whether democratic or totalitarian, represent the constituencies that keep them in power. Those constituencies

impose certain traditions. Popular expectations for the future must be pursued. A complete reversal away from traditions and expectations would destroy the confidence of the supporters in the government. If one has a small change in direction to recommend, then persuasion and pressure on government is an appropriate avenue of action. By its very nature, such a small change in direction is not sufficiently important to take before the public. But world modellers are dealing with radical change. They are raising doubts about the growth ethic. They must involve themselves in new concepts of moral behaviour and the appropriate responsibility of one people for another. They must change governments from blaming their difficulties on other countries, and instead lead governments into seeing that the world's problems are generated from within countries. Probably no government is strong enough to take such actions on its own initiative.

Thus I suggest that the proper role for world modelling is to build public opinion. If it is to be effective, it must provide leadership of the public into new attitudes. When new visions of the future have been established, when a long-range view has become clear enough to displace short-term expediency, and when public attitudes compatible with a finite world have been crystallized, then governments will fall in line with public opinion. The public will elect representatives who share their concern about the stresses arising from growth in population and industrialization. A member of the US Congress told me that he had decided to run for public office because of the *Limits to Growth* book. The world needs more of that kind of response. World modellers should be talking not to present governments but to that whole spectrum of people beginning with school children who will elect and who will be future governments.

I believe that the hope of exerting such influence is not an idle dream. *World Dynamics* and *Limits to Growth* excited the public at a time when their themes could not possibly have been embraced by the President of the United States. Such ideas were so contrary to the accepted folklore that they could not be debated in many governments. For such controversial messages, we in an independent, private-citizen capacity were in a position to have a far greater impact on public thought than could have been imagined for public officials.

The modeller must see himself as a leader, and feel that he belongs within the practical, operating, real world. He must understand and share the concerns of his audience. His methods must communicate with that audience. He must not put himself in the peculiar, narrow, self-limiting role so often adopted by social scientists to fit a self-generated image of the scientist as detached, plodding, taking small steps, basing his work securely in fully reproducible data, and addressing only colleagues within his own circle.

In short, the modeller must have the vision to deal with the big issues, the courage to address controversial subjects, and the empathy to identify with the concerns and fears of the public.

The System Dynamics National Model

The life cycle of growth, the economic long wave, and the business cycle are most easily combined at the national level. To look at a broader range of social and economic issues than were contained in *World Dynamics*, we at MIT started

to model behaviour at the national level, and have been developing and using the System Dynamics National Model.

The National Model is built up from the microstructure of an economy to produce several observed modes of macrobehaviour.²² Unlike many earlier system dynamics models, the objective has been to combine different modes of behaviour that span several different time horizons. In the 3–7 year time frame, the National Model generates business cycle behaviour out of the interactions between backlogs, inventories, and employment. In the intermediate range, it exhibits factor rebalancing between labour and capital that generates the Kuznets cycle of some 15 to 20 years between peaks.²³ In the longer time frame of 45 to 60 years, it generates the economic long wave as a consequence of the growth and collapse of capital-producing sectors. In the span of 200 years, the National Model will deal with the issues raised in *World Dynamics* as population, industrialization, and pollution impinge on geographical limits.

This model grows out of earlier work in corporate modelling²⁴ rather than being based only on macroeconomic theory, and contains several industrial sectors, each being a comprehensive model of a typical corporation in that sector. A sector acquires factors of production, produces, maintains inventories, responds to order backlogs, sets prices and wages, borrows money, and maintains a full accounting system yielding profit-and-loss variables and a balance sheet. Market clearing is not based on price alone, but also on availability and delivery delays.

The System Dynamics National Model is not limited to the USA, but is applicable to other developed and indeed developing countries. The behaviours described by the model are being encountered in most countries.

Our work is divided between continuing development of the National Model itself, and applying it at each point in time to interpret those issues in economic behaviour for which it is appropriate. In the area of policy and interpretation, we are giving top priority to a better understanding of inflation, to how the economic long wave causes major depressions, and to the problems of growth as manifested in energy policy and oil depletion. Recently, we have prepared a paper evaluating the domestic policies of the Reagan administration and the consequences to be expected from budget reduction, tax reduction, and a tight monetary policy.²⁵

Taking inflation as our first priority application, we have identified several mechanisms that cause prices to change. The least important, like price changes arising from business cycles, have received the greatest attention from those in politics and economic research. The longer-term effects of cumulative government deficits and continuing creation of new money have not been sharply enough distinguished for the public to understand where the critical elements lie in the inflation puzzle.

Our second area of application has been to the economic long wave,²⁶⁻²⁹ a controversial subject. I believe the System Dynamics National Model is beginning to provide the first coherent theory of how the long wave is generated, and to relate that theory to the historical evidence for the long wave, thus unifying many observations previously thought contradictory. We see these waves as the source of much of today's rising unemployment in industrial economies. Simultaneously, misguided policies based on business cycle interpretations have been

leading to money creation and inflation. Stagflation (simultaneous unemployment and inflation) has been puzzling because it arises from a combination of two quite different dynamic modes. The long wave creates unemployment at its crest and during the downturn. The business cycle produces data that have been erroneously interpreted as indicating that more money will counteract unemployment. More money has little effect on employment from the long wave, but is the fundamental cause of inflation. Stagflation is a consequence of unemployment from the long wave superimposed on inflation arising from money creation.³⁰

Energy and its effects on capital investment and standard of living have been our third policy area. Problems of oil supply and energy relate to both the economic long wave and, via reserve exhaustion, to the life cycle of growth. The economic long wave has historically been coupled to a sequence of energy sources (from wood to coal, from coal to oil); that we will shift energy sources again is thus consistent with the long wave – although the next energy transition may be of an unprecedented nature arising from the life cycle of growth: the transition will be to a higher-cost source of energy.

Summary

The most important questions facing nations and the world fall within the scope of world modelling. Only through better models can the complexities of population growth, industrialization, and quality of life be understood. Many nations are now pursuing goals that will intensify the world-wide stresses. World modelling should strive for consistency between national objectives and aggregate world well-being, and consistency between present policies and hopes for the future.

To be effective, world modelling should enter directly into the political processes, but from a position of objectivity and high integrity, not merely to support traditional or emotionally inspired objectives. Modelling should relate to present human concerns, but should draw political processes onto an enduring foundation of physical and social reality.

World modelling should contribute to moral and ethical aspects of relations between nations. Ethical values are part of the policy structure of society. Morality has a time dimension; what is good in the short run may be evil in the long run. Simple belief in a timeless morality, which will serve equally the present and future, can be destructive when applied during the dramatic changes in human affairs that will occur in the next 100 years. Modelling can contribute to a better understanding of moral issues by showing how social values guide the tradeoffs and compromises that must be made between present advantage and future well-being.

To achieve its maximum contribution, world modelling should span the institutional range from the world as a whole to national policies. At the world level, a legal framework should be identified within which nations can solve their own problems without transferring them onto others.

In the details of modelling, several major issues should be debated. Is regionalization of a world model an effective expenditure of time? Does regionalization give insights that could not better be obtained by working at the two

ends of the aggregation spectrum, at the composite world level, and at the national level? Can population be excluded as an active internal variable of a model? Is not population the most important variable to be controlled, as we seek a balance between man and the capacity of the world? What is the appropriate time horizon for world modelling? Should it not include the entire interval of adjustment between present expansion and future equilibrium? Is world modelling making best use of the available data? Is there too little use of information that is available from the written and mental databases? Is world modelling dealing with the timely issues? Are the issues now being addressed those that best serve current progress in thinking about the world problematique? What methodologies should serve what roles in world modelling? Considering the impact from early system dynamics models, is system dynamics underrepresented at present?

Who is the world modeller? Is he subservient to existing political forces, or is he a leader of world thought? And who is the audience for world modelling? Is the audience restricted to government officials, or should modelling be addressing the public from which will come the next several generations of leaders and their constituencies?

World modelling is so important that it should move in the most effective directions. The time has come to discuss the role of world modelling and the most promising approaches for fulfilling our obligation to civilization.

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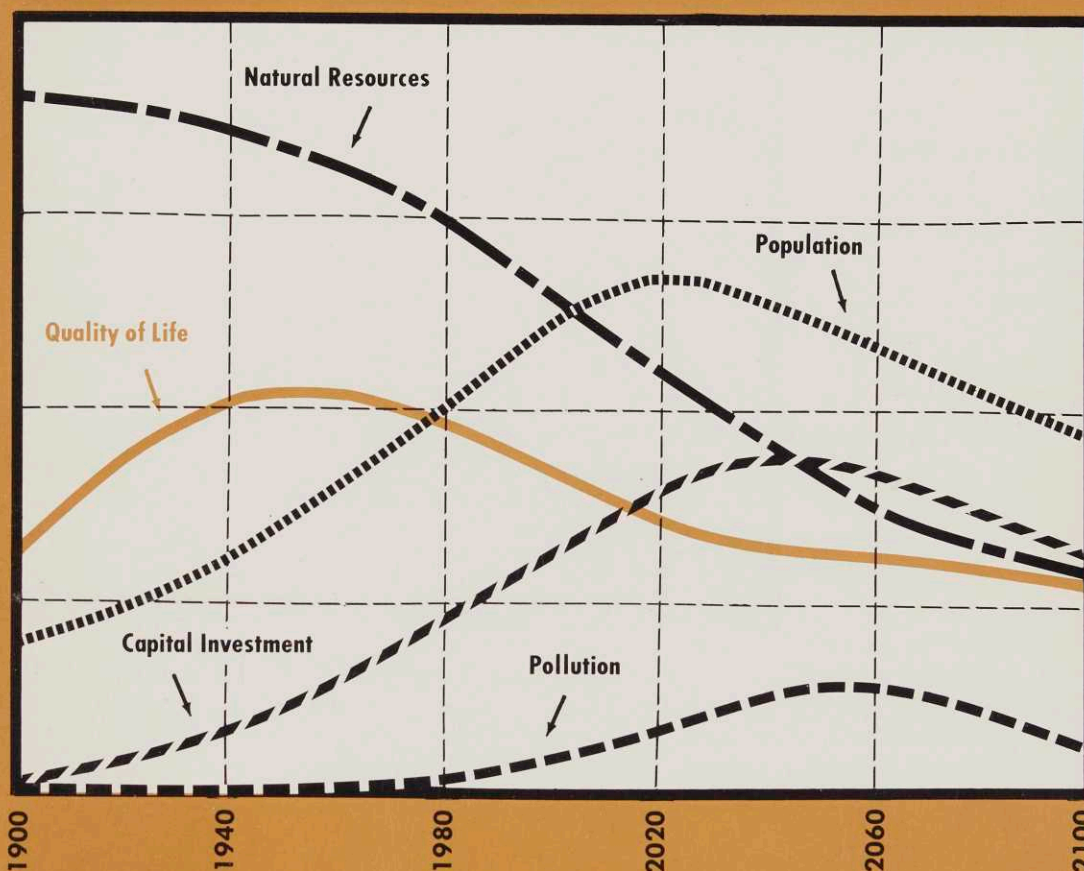
THE FUTURIST

Vol. V, No. 4

August 1971

Are We Living in a Golden Age?

Computer simulations of world trends suggest that mankind is moving into a mounting crisis as the world's rapidly growing population and industrialization exhaust natural resources and pollute the environment.



The Future of Marriage: Some Novel Proposals
Electrical Stimulation of the Brain: Should Man
Take a Short Cut to Happiness?

a journal of forecasts, trends and ideas about the future

Tomorrow Is Built Today

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Newspapers and magazines give relatively little space to important trends, which are rarely sudden dramatic events. This column seeks to focus attention on significant developments that may have been under-reported by the news media. Readers are invited to make suggestions or submit reports of such developments for possible use in this column. Please include the source of information.

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The world population total at midyear stood at 3,561,000,000, and is growing at about 2% a year.

The U.N. *Statistical Yearbook* also said that world industrial production expanded by 114% during the 1959-69 period.

(“U.N. Finds Food Off in '69 While Population Rises,” Reuters dispatch in *Baltimore Sun*, July 14, 1971.)

FAMILY

U.S. Divorce Rate Jumps; More Young Adults Stay Single

The divorce rate in the United States has risen from about one marriage in four in 1960 to one marriage in three in 1970, according to U.S. Census statistics.

Many young adults now appear to be avoiding marriage, recent reports suggest. John G. Theban, executive director of the Family and Child Services Agency, says that young people are finding “a different way of life, a substitute for marriage” in communes and other forms of group living.

The Washington Center for Metropolitan Studies reports that the Washington, D.C., area has had a huge increase in the young single population. The Center said the increase seems to “reflect changing sexual mores, with a growing number of local youngsters preferring informal liaisons to formal marital relationships.”

Some married people now have cards printed to announce to their friends that their marriage has broken up. One such card sent out in 1971 shows the sender in a revolving door. The message reads: “1971 . . . A TURNING POINT: MARCUS & I HAVE SEPARATED.” The sender explains: “It is the best way of informing everyone at once without going through the travail of making endless phone calls and endless explanations. It makes it much easier not only for us but for our friends.” It is possible that greeting-card manufacturers may come up with a selection of divorce, separation and reconciliation cards.

Editor's Note: For a variety of novel ideas on marriage, see page 166 of this issue of **THE FUTURIST**.

(“Easy Divorces” by Nina Totenberg in *The National Observer*, February 15, 1971; “More and More Are Alone,” *Evening Star*, Washington, D.C., April 18, 1971, “Love, Marriage, and Divorce,” *Washington Post*, February 2, 1971 and “Divorce Card,” *Parade*, May 9, 1971.)

CIVIL RIGHTS

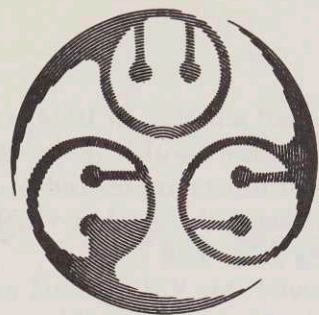
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The recent extension of voting rights to women in Switzerland and to 18-year-olds in the United States highlights a long-term world trend towards a universal franchise.

As late as 1937, universal suffrage for all adults existed in only 12 European countries, Canada, Australia, Cuba, and 18 U.S. States. High minimum age limits or a requirement that a voter must be the head of a family ensured a conservative electorate in many other countries.

Today, women have equal voting rights almost everywhere, and there is comparatively little disparity in minimum voting ages. Andorra has the highest minimum age, restricting suffrage to 25-year-old males. The minimum voting age of 21 prevails in 63 other nations. Twelve others have a minimum age of 20. Austria has adopted 19 as its limit. Forty-seven countries use the 18-year mark and Indonesia recently enfranchised 17-year-olds.

(See *The Atlas of To-day and To-morrow* by Alexander Rado, London: Victor Gollancz, 1938; and the 1971 *Information Please Almanac*, pp. 328-9.)



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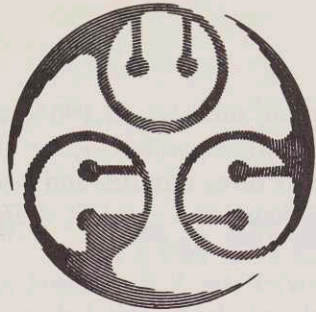
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SPORTS

Man Improves His Athletic Performance

In 1868, William Chinnery ran a mile in a second under four and a half minutes. In 1954, another Briton Roger Bannister broke the four-minute mile. Today Bannister believes that within another 30 or 40 years a man may be able to run a mile in three and a half minutes. The record now stands at three minutes and 51.1 seconds.

When the *Guinness Book of Records* was first published in 1955, it listed the greatest weight lifted overhead as 436.5 pounds. The record has since climbed to 503.75 pounds.

The high jump record in 1955 was 6 feet 11.5 inches. In 1963, Soviet star V.N. Brumel achieved 7 feet 5.75 inches and in 1970, the New China News Agency reported that Hi-Chih-chin had topped that with a jump of 7 feet 6.125 inches.

(See *New York Daily News*, Dec. 18, 1970; *Washington Daily News*, April 30, 1971; *The Guinness Book of World Records*.)

FAMILY

Fewer Babies Are Available for Adoption in the U.S.

New abortion laws, easier access to contraceptives, and the wider acceptance of illegitimacy are cited as contributing to an acute shortage of white infants available for adoption.

In New York City, where an abortion reform measure took effect in July 1970, there are ten applications from would-be parents for each white, non-handicapped child up for adoption. Elsewhere, adoption agencies in States with reformed abortion laws report similar, if less dramatic imbalances. The number of legal abortions in the U.S. has risen from 18,000 in 1968 to 200,000 in 1970.

The supply of black and other minority group children still far exceeds demand, and increasing numbers of white people are adopting them despite legal obstacles in many states.

(*Washington Post*, February 14, 1971; "Adoption Crisis: White Families, Black Children," by Peter Benchley, *Washington Post*, June 13, 1971)

NUCLEAR WEAPONRY

Pause Appears in Expansion of Nuclear "Club"

Until recently it seemed that the number of nuclear powers might continue to expand indefinitely. Every five years since Hiroshima saw a new admission to the nuclear club: the USSR in 1949, Great Britain in 1952, France in 1960, China in 1964. But, in the last few years, a large number of countries have ratified not only the Nuclear Non-Proliferation Treaty but, when applicable, the Treaty establishing a Latin American Nuclear Free Zone.

Today, the five nuclear powers account for about 36% of the world's population. Some 24% of its population live in the 75 countries that have renounced possession of nuclear weaponry.

The rest of the world's population live in nations that have yet to construct or renounce construction of nuclear weapons. While some have signed but not ratified the Non-Proliferation Treaty in protest against what they believe is an effort to make permanent a nuclear monopoly by the "Big Five," others are simply unwilling to take a decision which might mean permanent "second class status" or contrarily, exacerbate the tensions with their neighbors.

Nations holding open their nuclear option include: Albania, Algeria, Argentina, Australia, Belgium, Chile, Colombia, Congo (Brazzaville), Cuba, West Germany, Guinea, India, Indonesia, Israel, the Koreans, Netherlands, Pakistan, Portugal, South Africa, Spain, Switzerland, Turkey, the U.A.R., and both Vietnams.

(Treaty information from the U.S. Department of State. Population estimates from 1949 and 1971 *World Almanacs*.)

The Predicament of Mankind

Man appears to be heading toward a calamitous Day of Reckoning. Unless his rapidly growing population and expanding industrial capacity is somehow brought under control, the earth's natural resources will be exhausted and the environment so polluted that the world no longer will be livable.

Every year the earth gains about 70 million people. By the year 2000—now less than 29 years away—the world could have seven billion people (twice as many as now), and possibly even more.

Overpopulation is an old story to biologists, who have studied the phenomenon in animals ranging from deer to fruit-flies. When food is abundant, an animal population increases until the food supply no longer suffices; then many of the animals starve to death or, malnourished, fall easy victims to disease and predators. The die-off reduces the population until the food supply is again adequate, whereupon the process may begin again—provided that no non-renewable essential resources have been destroyed or consumed in the process. Unless man finds some way to limit his population growth, he appears to be headed for such a die-off.

The rise in population is accompanied by vigorous efforts to build more power plants and factories and produce more goods so that people can enjoy a higher standard of material wealth. This growing

industrialization intensifies the pollution caused by mushrooming population—and it uses up the earth's natural resources at an ever more rapid pace. Many of these—coal, oil, natural gas, and high quality mineral ores—are impossible to replace.

Some scientists suggest that, before the human race is checked by starvation, it may be suppressed when the air becomes unbreathable and the water undrinkable. Even if a few human beings survived, they could not recreate civilization because the essential mineral resources would then have been used up.

Concerned about the approaching crisis, Italian industrialist Aurelio Peccei formed a group of scientists, economists, educators, and businessmen known as the Club of Rome. The Club located financial support for a team at the Massachusetts Institute of Technology to apply the systems dynamics method developed by Professor Jay Forrester, in a computer simulation model of global interactions of population, natural resources, pollution, capital, and food production.

This issue of THE FUTURIST presents a series of articles dealing with the Club of Rome's work and its possible significance. The first article is by Professor Dennis Meadows, director of the Club's "Project on the Predicament of Mankind."

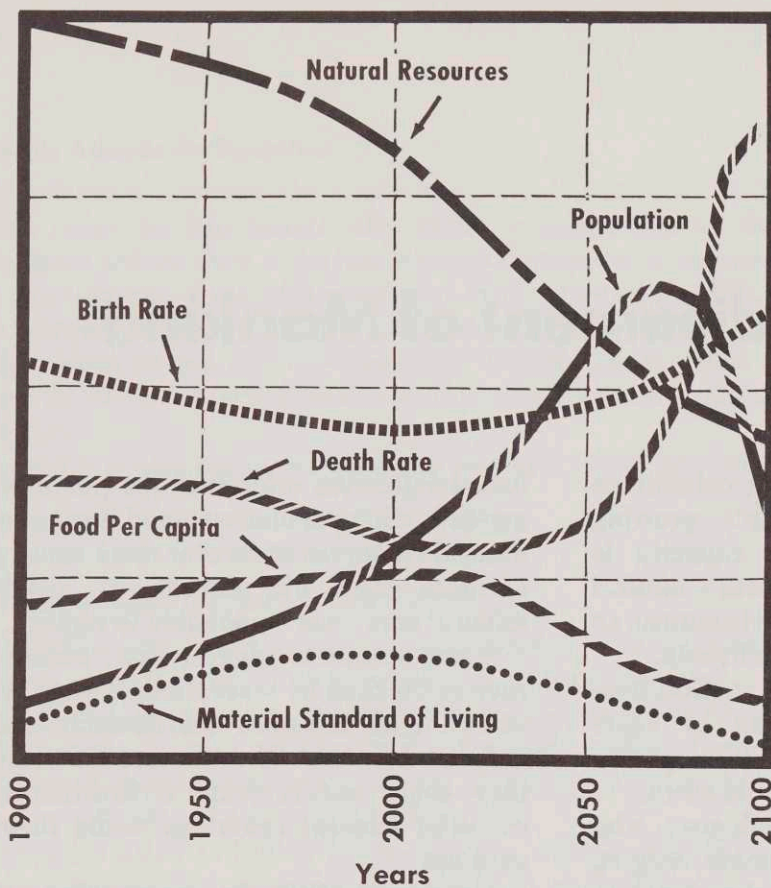
by Dennis L. Meadows

Three convictions unite the members of the Club of Rome:

1. The long term prospects of our global society are poor at the moment, and the situation appears to be deteriorating.
2. The only viable solutions to global problems will be those with a transnational perspective and a planning time horizon much greater than those currently exhibited by any state.
3. Scientific attempts to identify the fundamental interactions which determine the rate and direction of global evolution, realistic assessments of our feasible options, and con-

certed efforts to achieve a more satisfactory global situation can lead to a substantial improvement over our current situation.

Within the context of those convictions, an MIT team under my direction has been engaged in a set of empirical research and simulation modeling studies to identify the long-term global prospects and to evaluate alternative policies in terms of their impact during the next 50 to 200 years.



This sample simulation of the global model used by the M.I.T. researchers shows how the depletion of natural resources could halt population growth. This projection, which may be compared with the earlier projection on the front cover, shows a rapidly rising death rate in the latter half of the 21st century.

We are not demographers or economists, but system analysts. In the past, members of our Systems Dynamics Group have carried out other studies of systems ranging from internal body medicine to urban decay. Now a subsection of the System Dynamics Laboratory is working on global simulation. We have been looking at the various aspects of what I consider to be the world's great challenge—negotiating some form of orderly transition from worldwide growth in population and capital accumulation to an equilibrium in those two elements so that they would be very much more in balance with the globe's finite resources.

We have begun with a major model which relates global population growth, pollution, food production, natural resource depletion, and economic development. The initial version of that model is finished and we have moved on to a subset of models which examine problems in each one of those five major sectors in much greater detail. The work is being conducted in cooperation with professionals outside our university, in economics, demography, economic development, agricultural economics, and so forth, because we recognize that we don't have special expertise in those areas. The first version of the main model was prepared by Professor Jay Forrester last summer to serve as a basis for our conversations with the Club of Rome, and appears in his book, *World Dynamics*. (See review in this issue of *THE FUTURIST*.) The first version of the main model is very simple and has not been empirically validated, but it makes some very important points about the major determinants of global evolution.

This past year the group under my direction has been involved in extending that model and converting it to a research instrument which is accessible to demographers and other professionals. As revised, the main model uses the terminology of various professionals in the appropriate sectors, and draws on their theories and their data. We have disaggregated the model, that is, separated out its various

parts so that each could be studied individually. We have also tested the whole model and have generated a series of initial conclusions. I would like to focus on them and be a little more specific about our main model.

Population Growth Rate Must Soon Slow

The world population now stands at 3.6 billion people and its doubling time is 32 years and decreasing. Many other aspects of global growth have doubling times of 7 to 10 years. This population growth is the end result of a sequence of industrial, medical, and agricultural innovations which began about 200 years ago in England. The growth rate is absolutely unprecedented in history. Until about 200 years ago the doubling time for population was about 1500 years. It had been close to that throughout all recorded history. **Today's growth rate is very transient phenomenon, and one whose end most of us will witness.**

We see absolutely no possibility on the basis of the work we have done over the last year of supporting 14 billion people on the globe, even momentarily. If you will accept that conclusion for purposes of discussion, it means that **we will witness, some time in the next 50 years, a very, very strong transition to a much slower population growth, and with that, a much slower rate of capital accumulation.**

Simulation is, I believe, the only analytical approach capable of understanding the determinants and implications of that transition, its different possible configurations, and the way in which we can impact on it with our current policies. Simulation is the only tool available to provide the foundation that we need in order to begin to look at the problem. Most analytical tools developed by the social scientists will ultimately be used to get data for the models used in simulations. And simulation also is needed to identify the critical data and to provide a conceptual framework through which they may be related.

Our group at MIT has developed a model of the interactions among population, pollution, natural resources, food production, and economic development. The model permits a variety of useful policy analyses, but we do not conceive of it as the end result of our work. Implementing policy in the real world requires a time horizon and degree of detail inappropriate in the global model. Thus more detailed simulation models must be undertaken to bridge the gap between long-term global behavior and short-term regional policy making. A global model is useful only if it gives you an overall context for the detailed models.

Let me give you just a simple example: If one focuses on starvation as a global problem, it is very easy to decide that the main objective of the agricultural sector is to provide food. If you attack the problem in that context you come up with the Green Revolution, a brilliant success in terms of

producing food. But from the global model we see that an equally important function of the agricultural sector is to provide employment. In most areas of the world there are no effective funds transfer mechanisms which can ensure at least a minimum purchasing power for the unemployed. Only employment can serve as a means of obtaining income. For most of the world's people, employment comes only through agricultural work. The Green Revolution may very well create massive unemployment in the agricultural sector. By looking at the interaction among the various sectors with a global model, you are more likely to avoid a dangerous, suboptimal solution.

World 3: The Global Model

Let us now look a little more closely at the interactions of population and capital, which strongly influence all global

The Club of Rome

The rather informal organization known as the Club of Rome has attracted much interest in the past year or two.

The Club was founded by Aurelio Peccei, an internationally known Italian economist and businessman, who is vice chairman of the board of Olivetti, a member of the board of Fiat, managing director of Italconsult (an Italian think-tank), and chairman of the Committee for Atlantic Economic Cooperation.

Peccei founded the club in 1968 and invited about 50 scientists, humanists, economists, planners, educators, and industrialists of different countries to study the problems of the world future from a global standpoint.

At a meeting in Bern, Switzerland, in June 1970, the Club heard Jay Forrester, Professor of Management at MIT, discuss his systems dynamics theories. The Club decided to commission Forrester and his associate, Dennis Meadows, to develop a simulation model of the world. The Volkswagen Foundation (Stiftung Volkswagenwerk) put up funds for the project. This "Project on the Predicament of Mankind" at MIT would be followed by a second phase in Geneva, where the most critical aspects of the world situation will be studied.

Members of the Club include people like Hugo Thiemann, head of the Battelle Institute in Geneva; Alexander King, scientific director of the Organization for Economic Cooperation and Development, and Saburo Okita, head of Tokyo's Economic Research Institute.

In an article in the Italian magazine *Successo*, (February



Aurelio Peccei, founder of the Club of Rome, urges a union of the Atlantic nations—and solidarity with the Soviet bloc—in order to cope with urgent global problems.

1971), Peccei summarizes his analysis of the global predicament:

- Metamorphic changes are transforming human ecology both in its elements—man, society, environment—and their interrelationships. "Although we are the prime agents of these waves of change, they are much too swift and drastic for our capacity to adapt—biologically and psychosocially."

- Technology is becoming ever more powerful and its benefits are well known, "But we are so intoxicated by its magic as to forego control over it and overlook the unwanted side-effects or consequences of its use or abuse."

- We wield incredible power but are poor in the wisdom and rationality needed to use the power properly. "While the stream of human activity grows bigger and faster, we are no wiser to grasp where it leads us, or to re-order and re-direct it."

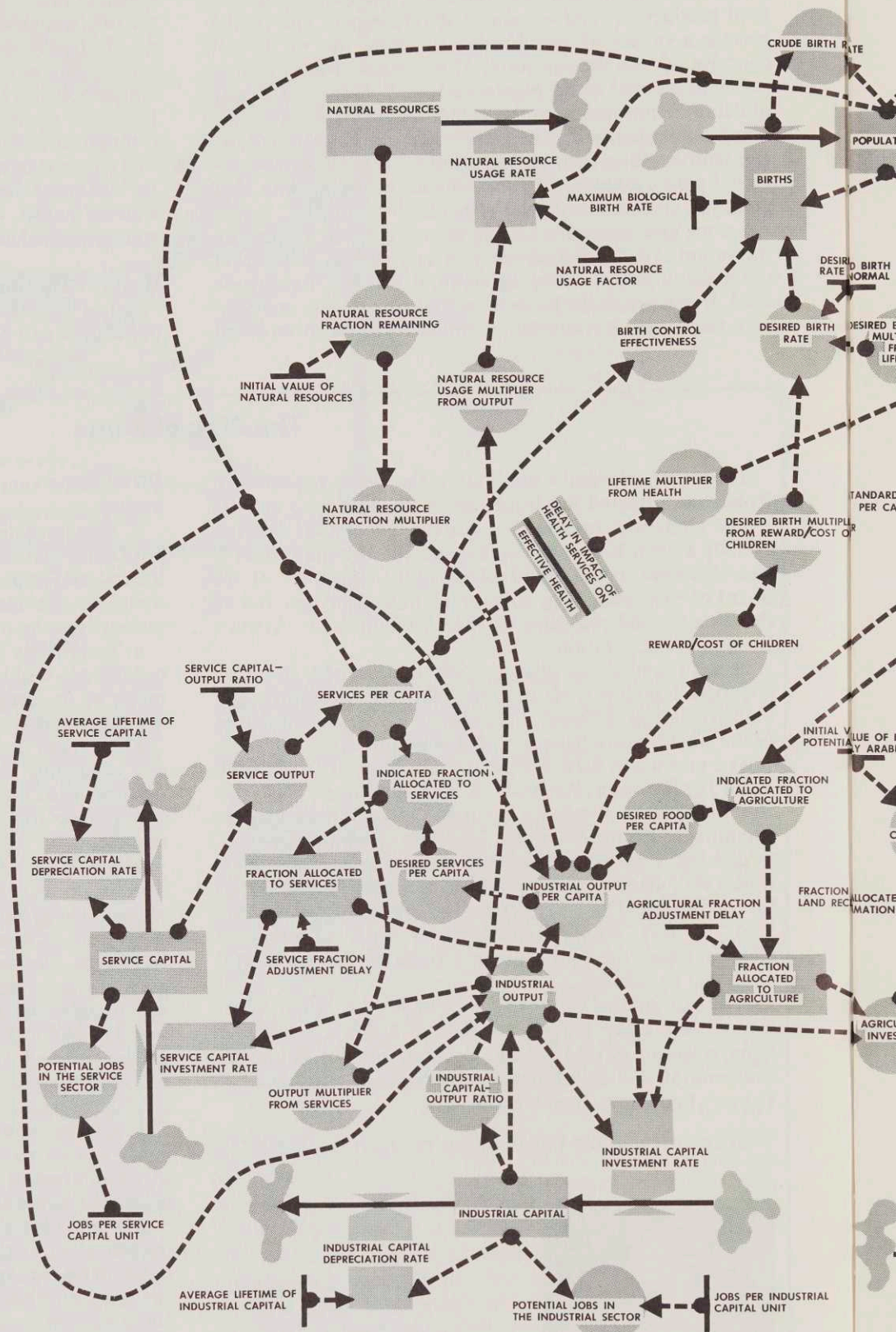
- People do not yet realize that the world is now heading toward macroscopic disorders—ecological, political, and social. "These are not just ghosts of the future. An undeclared state of emergency already exists now. And alarming symptoms appear practically everywhere, warning that grave ills are simmering, and may flare up at any moment with worldwide repercussions."

- The global threats overarch man's traditional national, ideological and racial divisions. "Hence the need for a supreme effort to overcome this unprecedented situation, uniting the peoples of the world behind a common purpose. This general mobilization of goodwill and resources does not relieve the most developed countries from the obligation to set an example—by initiating the movement and shouldering the greatest part of the burden."

- A first objective must be to increase understanding of the true state of the contemporary world and society, and particularly the explosive interaction of the formidable ever-changing problems which make all situations so unstable and uncertain.

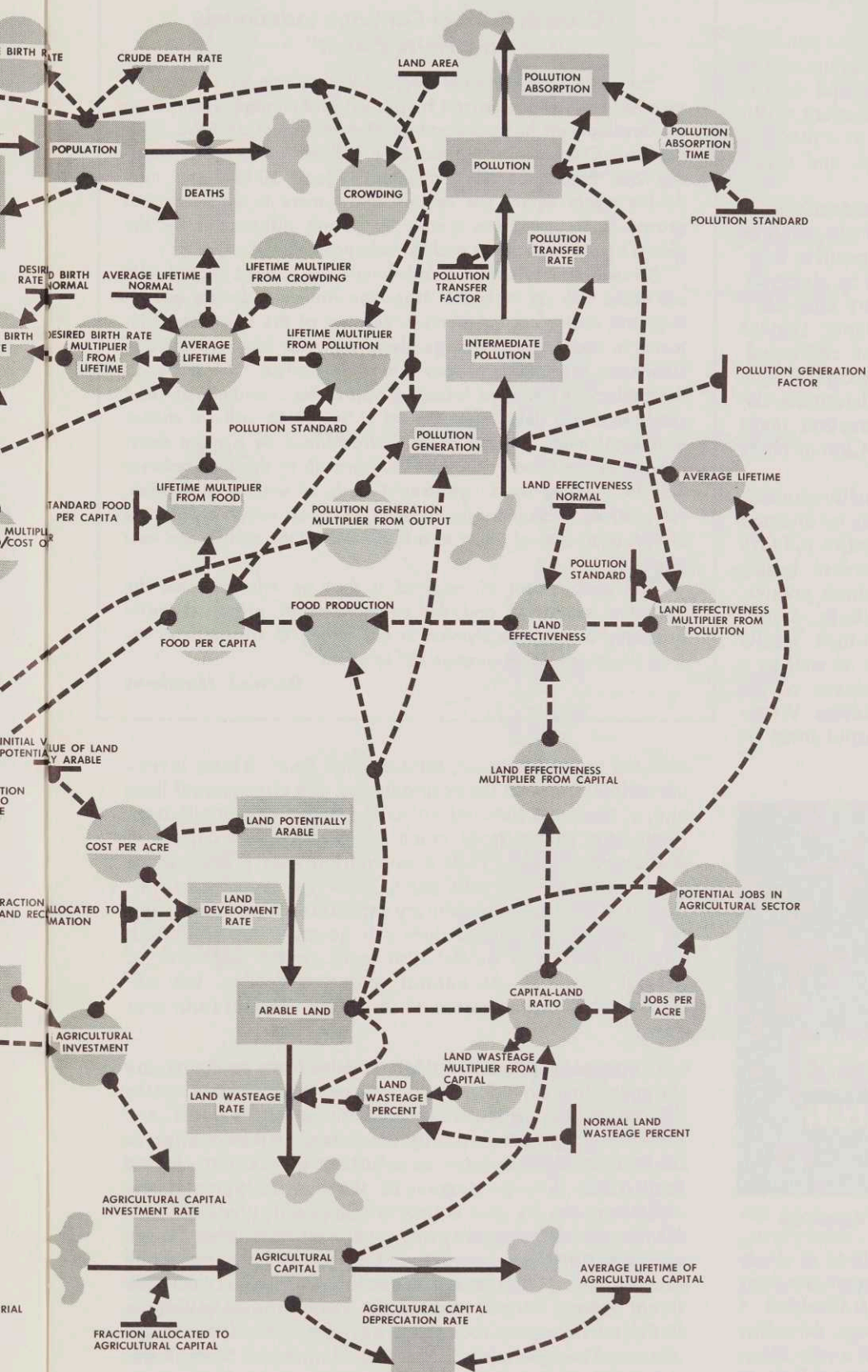
"Both philosophically and operationally, a reasonably good knowledge of the dynamic present—and how it differs from the past, and what kind of future it may herald—is the starting point of everything."

(The Club of Rome's address is Via Giorgione 163, 00147 Roma, Italy.)



"World 3": This flow diagram represents the interactions that the M.I.T. researchers assume take place in the real world. The assumptions, based on human scientific judgments, are given to a computer, which can keep track of the huge number of interactions that take place—a feat that the human mind is incapable of.

The rectangles represent "levels" (population, pollution, etc.). Valves (figures suggesting fire extinguishers) are "rates" (birth rate, death rate, etc.), which directly determine levels. Circles are "auxiliaries"—various factors that strongly affect rates. (Birth control effectiveness is one auxiliary.) Clouds (irregular figures) are levels that are considered to be unim-



portant in the simulation.

This chart, based on an original plotting of data by Forrester, Meadows, and their colleagues at M.I.T., was prepared for the World Future Society by Nancy Montague of the Society's staff. She also prepared the other charts in this issue of *THE FUTURIST*.

problems—unemployment, starvation, disease, pollution, the threat of warfare, and resource shortages.

No attempt to understand our long-term options can succeed unless it is firmly based on an understanding of the relationships between population and capital and of the ultimate limits to their growth. World 3—our current world model—explicitly represents the growth forces as a function of the biological, political, economic, physical, and social factors which influence them.

Population and birth constitute a positive feedback loop. More people produce more births and more births result in more people. Wherever there is a dominant positive feedback loop of this form, exponential growth will be observed. Wherever exponential growth is observed there must be a positive feedback loop of this type. For example: Capital produces industrial output; Greater output, all else equal, results in a larger investment and thus in more capital. The interactions among population and capital determine the rate at which each of them grows. The interaction takes many forms, as suggested by the Population-Capital chart accompanying this article.

If a greater fraction of output is diverted from investment, the growth rate of capital decreases. Output may be diverted to consumption and services, to agriculture, and to military expenditures. As consumption and services increase, health and education improve, average lifetime becomes greater, deaths decrease, and population grows. Similarly, output may be diverted into agricultural capital which results ultimately in greater food and food per capita as well as a higher average lifetime. The primary determinant of the fraction of output reinvested is the output per capita. Where production per capita is low, most of the output must be



Author Addresses World Future Society's Assembly

Dennis Meadows of the Massachusetts Institute of Technology, tells Assembly attendees about the progress of the Club of Rome's Project on the Predicament of Mankind. A professor at MIT's Sloan School of Management, Meadows appeared on a panel organized by John McLeod of the Simulation Councils in La Jolla, California. The panel brought together scholars who are trying to find ways to simulate highly complex world conditions, particularly those affecting the quality of human life.

"Growth Cannot Continue Indefinitely on a Finite Planet"

"For some four thousand years the condition of the human race has been characterized by growth and change. Technological development has accelerated. Natural resources have been depleted. Our environment has been polluted at an ever-increasing rate. Population has multiplied at least 50-fold and may double again within this century. Now there is evidence that growth is occurring too quickly to permit adaptation by the planet's social institutions and its ecological systems.

"Growth cannot continue indefinitely on a finite planet. We are faced with an inevitable transition from world-wide growth to global ecological equilibrium. Because of the time delays inherent in social system change, decisions made now are already influencing the nature of that future equilibrium. Will it be an equilibrium of poisoned lakes, of oppressive crowding, of food shortage and a declining standard of living? Or will we choose a different mode of equilibrium characterized by a more desirable set of conditions? The shift from growth to dynamic balance may be initiated by a catastrophe such as war or starvation. Alternatively, transition could result from an enlightened, concerted, international effort to adopt new values and define new goals.

"The predicament of mankind is that we can perceive the individual symptoms and the components of profound social problems, but we are stymied in our efforts to comprehend the total situation and develop global solutions."

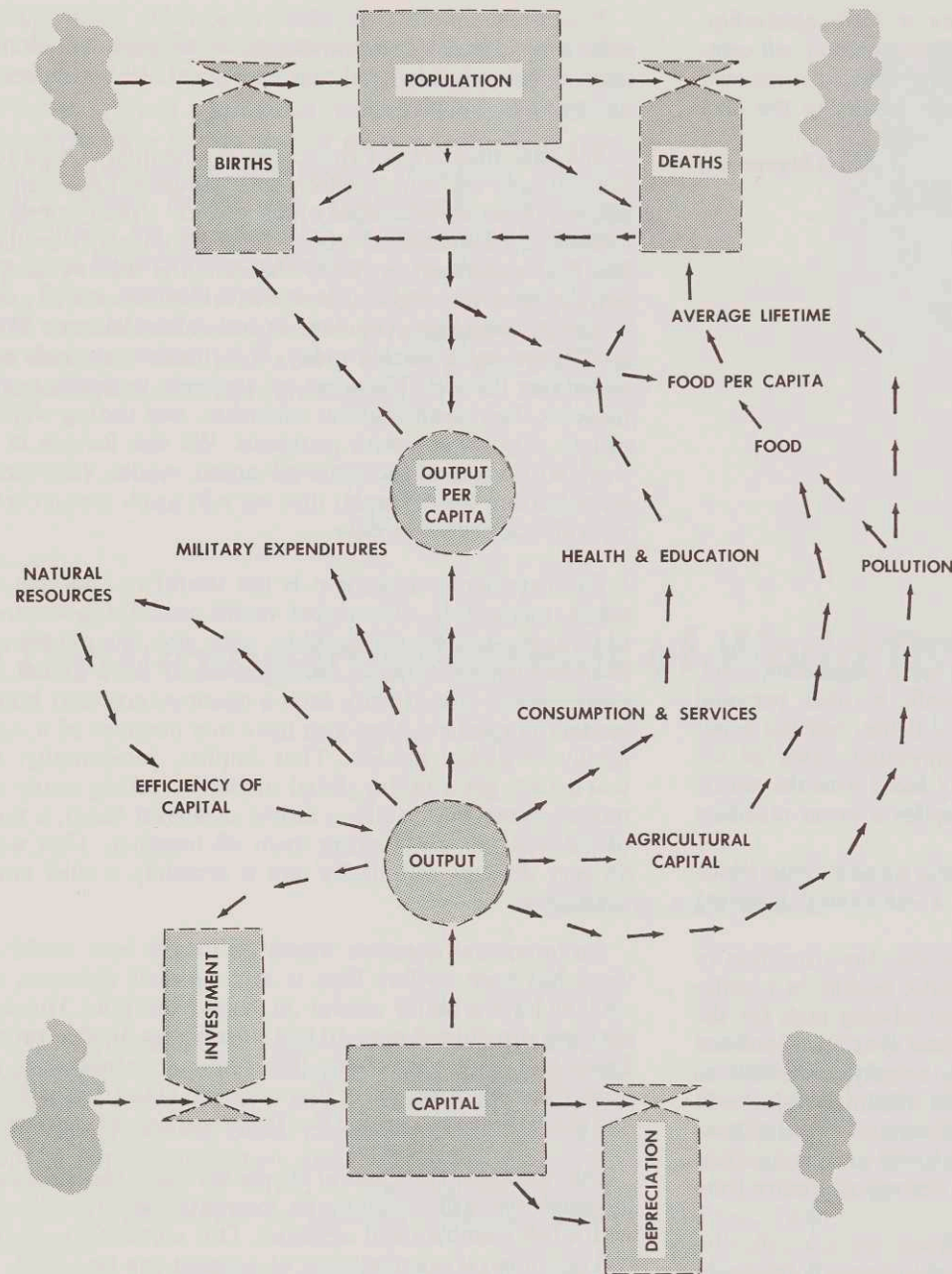
Dennis L. Meadows

diverted to consumption, services, and food. Those investments interfere with the accumulation of a large capital base and, at the same time, stimulate the growth of population. Population can increase much more easily than capital in traditional societies. Thus a population with a low output per capita finds it very difficult to achieve economic growth.

Output diverted into military expenditures subtracts capital from the system and does not generate future growth directly. Industrial output also leads to the depletion of natural resources. As natural resources decline, the efficiency of capital decreases and the output/capital ratio goes down.

Output per capita is the single positive force acting to slow the population explosion. As output per capita increases, the desired family size declines, the birth rate goes down, and population growth typically decreases. Additionally, as death rates decline there is a further decrease in desired family size. A large portion of the world's parents bear children primarily as a source of support in their old age. If there is a high mortality rate, one must bear three or four sons to insure that one will live. Thus as the perceived death rate decreases, birth rates also decline. Output has one additional impact. Output leads to the generation of pollution. Pollution decreases food, and also decreases the average lifetime. Most global problems have important roots in this simple set of interactions.

For example, behind the program to implement the Green Revolution has been the assumption that an exogenous increase in food production capabilities of the less developed countries would permit less output to be invested in agriculture and more to be reinvested in capital, moving the process of capital investment into the phase of self-sustaining growth. A secondary argument has been that the in-



Basic interactions between population growth and capital accumulation (represented by horizontal rectangles) may be seen in this chart. The levels of population and capital accumulation are affected by fluctuations in the rates (represented by valves in the chart) such as birth rate, death rate, investment rate, and depreciation rate. The rates, in turn, are influenced by the levels and by auxiliary factors (circles) such as output per capita. (Irregular figures or "clouds" represent levels that are considered unimportant.) The chart suggests the enormous complexity of social interactions: For example, a rise in the number of babies born will increase the population, and an increase in the population will increase the number of babies born (although the effect may be delayed). At the same time, the number of births may be affected by output per capita, which in turn is affected by output, which is influenced by capital.

creased food per capita would decrease deaths somewhat and thereby depress the birth rate.

In fact an alternative conclusion might be justified. The increased food from the Green Revolution might as easily increase the food per capita, decrease the death rate, and leave population to grow very rapidly. Should this happen, the increase in population might be very much greater than the increase in capital. Output per capita could remain the same or even decline, thereby drawing a larger percentage of output into consumption and services and maintaining the stagnant economy.

The Green Revolution has been implemented only for three years. Thus the resolution of this issue is still a few years off. However, it is ironic that while billions of dollars were spent in massive modeling efforts to think through every step of a program to land three men on the moon, no similar effort was made to understand beforehand the possible implications of the Green Revolution for our ability to maintain three and one half billion people on the globe. The global model is a first tentative step in the development of tools necessary for such analyses. The full set of assump-

tions are represented in the DYNAMO flow diagram. (See World 3 chart.)

Preliminary Conclusions from the World Simulation

The World 3 model is based on the best available data found and summarized through our six months of effort. It has been evaluated by experts in universities, in national governments, and in various United Nations agencies in the U.S. and abroad. There is little disagreement with the preliminary conclusions:

1. There is no possibility of sufficient technological and cultural progress occurring in the next 100 years to sustain as many as 14 billion people on our globe. Since the doubling time of population is currently 32 years and decreasing, this means that sometime within the next 60 years population growth will undergo a profound deceleration.
2. There is no possibility of bringing the vast majority of those living in the developing countries up to the material standard of living enjoyed by the developed nations.
3. There is a strong probability that the western nations will witness a marked decline in their own material standard

"We travel together, passengers on a little spaceship; dependent on its vulnerable reserve of air and soil; all committed for our safety to its security and peace; preserved from annihilation only by the care, the work and the love we give our fragile craft."

Adlai Stevenson

of living within the next three or four decades.

4. There is no unique, optimal long-term population level. Rather there is an entire set of trade-offs between personal freedom, material and social standard of living, and the population level. Given the finite and diminishing stock of resources on this globe, we are inevitably faced with the necessity to recognize that more people implies a lower standard of living.

5. There is, in theory, no fundamental human value which could not be better achieved through a substantial lowering of the global population base.

6. There is a very strong probability that the transition to global equilibrium will involve a traumatic decline in population. It is our conclusion that the overwhelming task for the Club of Rome is to identify and implement that set of policies which will permit us to negotiate an orderly transition to equilibrium. We must bring a transition which, though it will cause drastic changes, will leave us with most of the attributes which we value in our society and which will preserve options for those who must live on this globe a century and more from now.

No one we have talked with has offered any scientifically-based disagreement with the above conclusions. To the contrary, many at high levels of the United Nations, the World Bank and similar organizations hold personal opinions much more pessimistic than those of our project staff.

"In our social systems, there are no utopias. No sustainable modes of behavior are free of pressures and stresses. But many possible modes exist, and some are more desirable than others. Usually, the more attractive kinds of behavior in our social systems seem to be possible only if we have a good understanding of the system dynamics and are willing to endure the self-discipline and pressures that must accompany the desirable mode . . . To develop the more promising modes will require restraint and dedication to a long-range future that man may not be capable of sustaining."

Jay W. Forrester in *World Dynamics*

Now there are other problems concerning values, such as achieving an equitable distribution of income, but each of them is tempered by the characteristics of the impending transition to equilibrium.

We have thus far not found the availability of data to be a constraint on our research. We already know enough about the major processes which govern global interaction to construct more useful models than are currently available. **The real constraint on global simulation is that we lack the unifying theories of global evolution which indicate to us how it is that technology, population, and values interact. Where models are not available today, it is because we lack those underlying theories.** However, as we begin to develop those theories, their confirmation, extension, and testing will lead us into very serious data problems. We can foresee in our work with some of the more advanced models (the models on pollution, for example) that we will reach a point where we will lack necessary data.

Our experience suggests it is not useful to conceive of a single, monolithic, all-purpose world model. Good models bear a one-to-one relationship with specific phenomena. Many of the phenomena that interest us have global relevance. When you identify such a phenomenon and build a model to explain it, then you have one member of a whole family of global models. That implies, incidentally, that you do not get a useful global model by taking many sub-models, a model of a city, a model of a river basin, a model of the seas, etc. and linking them all together. That would be very difficult technically and it certainly would not be useful.

An important question would be to ask how useful our work has been so far. That is an empirical question, and we'll all have a better answer 20 years from now. However, we have distributed over 10,000 documents on this project. There will be presentations this summer to planning and scientific staffs from more than a dozen countries in North and South America, behind the Iron Curtain, and in Europe.

Our work for the Club of Rome formally ended in June, although we will continue to maintain close cooperation with Club members and activities. Our simulation research will continue, if other sources of support can be found. We are now searching for American institutions willing to fund extension of the preliminary work. Meanwhile, the Club of Rome currently plans to initiate related research activities in Geneva and several less developed countries.

We have taken the first halting steps towards the use of simulation to understand and control global problems. There are large research problems, to be sure, both in the theory of model building and in the availability of data. However, the real world problems are enormous—and there is not much time left to find and implement solutions.

(Dennis L. Meadows is Project Director, System Dynamics Group, Alfred P. Sloan School of Management, Massachusetts Institute of Technology, 50 Memorial Drive, Cambridge, Massachusetts 02139. Plans for publication of the Project's final report are expected to be announced later this year. In the interim, the Club of Rome plans to distribute 3,000 copies of a preliminary version entitled *The Limits to Growth: A Global Challenge*, to 3,000 policy-makers. The address of the Club of Rome is Via Giorgione 163, 00147 Roma, Italy.)

Professor Jay Forrester and his colleagues at the Massachusetts Institute of Technology have applied the system dynamics method to factories, to cities, and now to the world as a whole. The computer simulation of the world, described in Forrester's latest book, has profoundly disturbing implications for social policy. It suggests that man may now be living in a Golden Age that will soon end. Even more ominously, the simulation of world trends indicates that a catastrophe looms if man does not drastically slow down the growth of his population and industrial plant.



Jay W. Forrester, Professor of Management at M.I.T., warns that growth of population and capital investment must slow in the years ahead.

The Disturbing Implications of World Dynamics

A Review by Jon D. Roland

World Dynamics, published in June, is a preliminary report by Professor Jay W. Forrester on the computer simulation model called *World 2* and its 200-year projections of the interactions among global population, pollution, natural resources, capital investment, and food production. *World 2* was the predecessor of *World 3*, discussed earlier in this issue of *THE FUTURIST* by Forrester's associate, Dennis L. Meadows.

The *World 2* model is at a highly elementary stage of development. Its projections are not to be considered predictions so much as indicators for social policy. It is intended to demonstrate that intuitively acceptable assumptions concerning social systems can have counterintuitive implications.

Social policies, Forrester says, are now based on mental models of social systems. He contends that human intuition cannot reliably work out the implications of the assumptions made about such systems, and that reliance on human intuitive judgement is less likely to avoid catastrophe than to accelerate and intensify it. *World Dynamics* is a challenge to people everywhere to participate in the construction of computer models of social systems that are better than the intuitive models we rely upon now.

The systems dynamics method characterizes any system as a structure composed of two kinds of variables, *levels* and *rates*. In the *World 2* model, accumulated population and pollution are levels. The population level is increased by the birth rate and decreased by the death rate.

Levels are influenced by rates and rates by levels, but levels do not interact directly with other levels nor rates with

other rates. The population level directly affects the natural resource usage rate and the pollution generation rate, but it is only through the effect on the pollution generation rate that it affects the pollution level. Any system that changes through time may be characterized in this way (See Forrester, *Principles of Systems*, Cambridge, Wright-Allen Press, 1968).

Feedback Loops Confound Intuition

One of the principal concepts in this characterization is the feedback loop—which represents a situation in which a change in the value of a variable causes the system to reinforce or counteract that change. A feedback loop is called positive with respect to a variable if it reinforces a change in the value of that variable and negative if it counteracts such a change. A loop may be positive at some times and negative at others. There is a delay between the change and the reinforcement or counteraction, so that policies that work well in the short run may be disastrous in the long run.

An example of a feedback loop in action is a bus company which is losing money and raises fares in order to increase its income. This works for a while, but encourages the riders to find other forms of transportation. As a result, the number of passengers declines so much that after a while the bus company is losing even more money than it was before it raised the fares. This loop is negative with respect to fares if the managers of the company realize what is happening and reduce the fares.

It is the abundance of feedback loops in social systems that defeats the attempts of humans to model them intuitively.

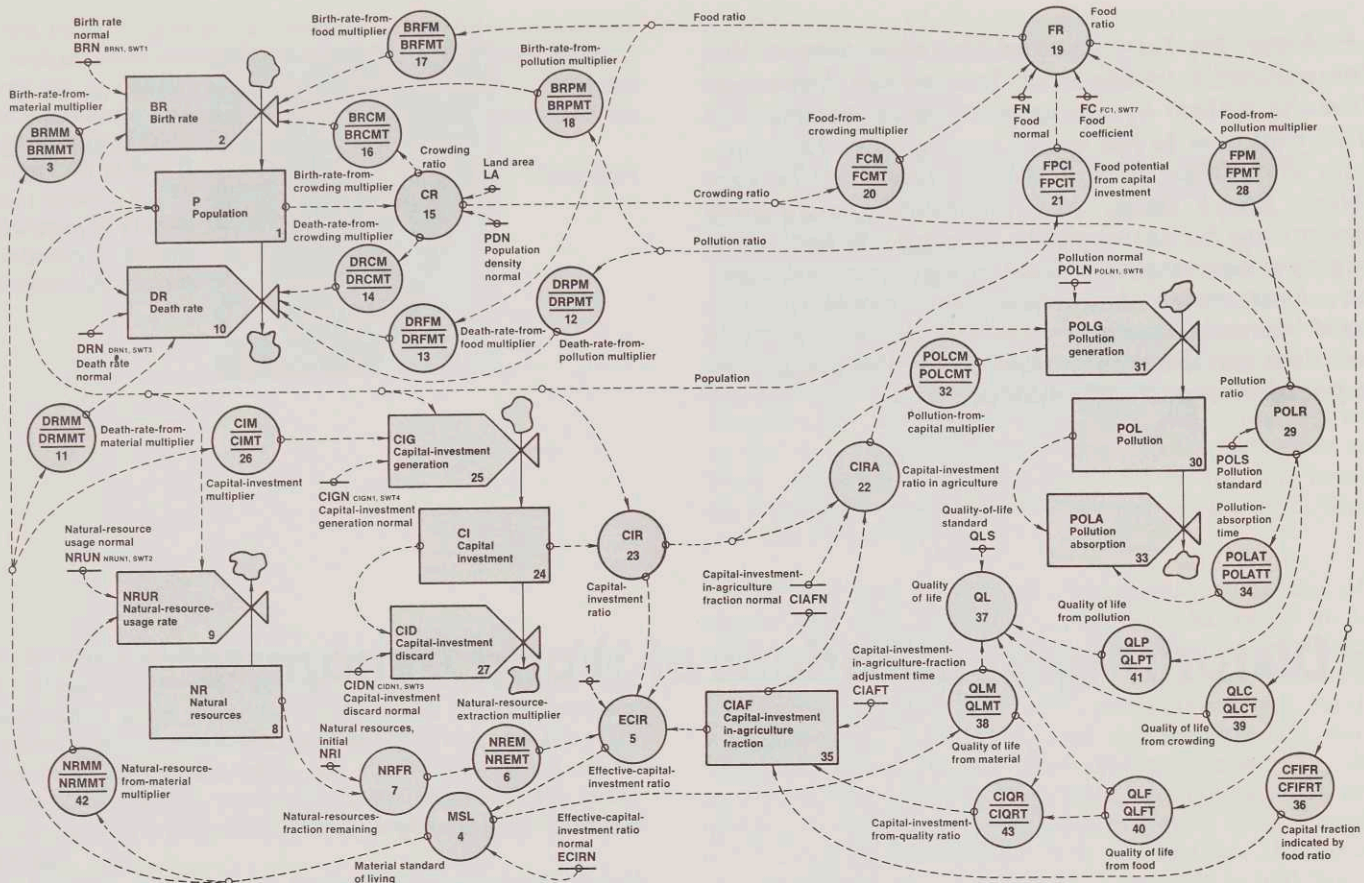


Figure 2-1 Complete diagram of the world model interrelating the five level variables — population, natural resources, capital investment, capital-investment-in-agriculture fraction, and pollution.

“World 2”: This is a complete diagram of the world model described in Jay Forrester’s *World Dynamics*. The model interrelates the five level variables—population, natural resources, capital investment, capital-investment-in-agriculture

fraction, and pollution. World 2 antedated the World 3 model described by Dennis Meadows in this issue of THE FUTURIST.

tively. The human mind comprehends complexity by separating it into parts and treating those parts as though they were independent of one another. They almost never are.

Forrester and his associates chose this characterization of systems to make it easier for persons without much training in computers to participate in constructing computer models. They use a computer language called *Dynamo* that is designed to make it easy for the programmer to translate his intuitive assumptions into programs (See *Dynamo User’s Manual* by Alexander L. Pugh III, M.I.T. Press, 1970).

A computer simulation model can be usefully understood as a *heuristic*—a search procedure that does not exhaustively examine all possible solutions to find the best one, but has a high probability of finding a fairly good one. It represents acceptance of a reduction in effectiveness for a reduction in the amount of searching that must be done.

World 2 Model Makes Straightforward Assumptions

There are five levels in the World 2 model: population, pollution, natural resources, capital investment, and the fraction of capital devoted to agriculture. In this model, birth and death rates depend on population size, food, pollution, crowding, and the material standard of living. Capital generation and the natural resources usage rate depend on population and the material standard of living. The rate of pollution generation depends on pollution and capital

investment, and the fraction of capital devoted to agriculture depends on the amount of food available to each person and on the total amount of capital investment.

The assumptions of the model are straightforward:

- Crowding, pollution, and a high material standard of living decrease the birth rate and food increases it.
- The death rate is decreased by food and an increased material standard of living, and increased by pollution and crowding.
- Capital investment in agriculture causes food production to rise rapidly at first and then more slowly.
- The rate of capital investment increases with increased material standard of living.
- Capital investment increases pollution, which in turn reduces food production.
- Increased pollution increases the time required for pollution to be absorbed by the environment.
- A variable called *quality of life* is increased by food and by material standard of living and decreased by pollution and crowding.

Model Suggests Desirable Policies

Several runs of the model with different values for the coefficients produced some interesting projections. All of them indicate that the growth of population and capital will be checked. They differ on which factor operates first—pollution, crowding, starvation, or resource depletion.

Simulations using realistic coefficients indicate a population dieback within 50 years, and that the longer the crisis is postponed, the more drastic and traumatic it will be when it occurs. The projections indicate that the developed countries may suffer more than the underdeveloped countries.

An attempt was made to find coefficients that would project a transition to an equilibrium with a high quality of life but without an intervening collapse of population and capital. Such a projection was found. To achieve it, the model indicated that there would have to be a drastic reduction in birth rates, in pollution, and in natural resource usage.

This indication is not surprising, but the model also indicated that there would have to be a drastic reduction in capital generation and food production! Such a policy would run counter to rising demands for food, housing, employment, and industrial development.

Even in this model, however, the equilibrium is only temporary. Resources continue to decline, though more slowly, and would eventually depress the system.

Although the model is preliminary, Forrester thinks that certain implications for policy emerge:

1. Industrialization may be a more fundamental disturbing force in world ecology than is population. In fact, the population explosion is perhaps best viewed as a result of technology and industrialization. (Medicine and public health are included here as a part of industrialization.)

2. Within the next century, man may face choices from a four-pronged dilemma—suppression of modern industrial society by a natural resource shortage; decline of world population from changes wrought by pollution; population

limitation by food shortage; or population collapse from war, disease, and social stresses caused by physical and psychological crowding.

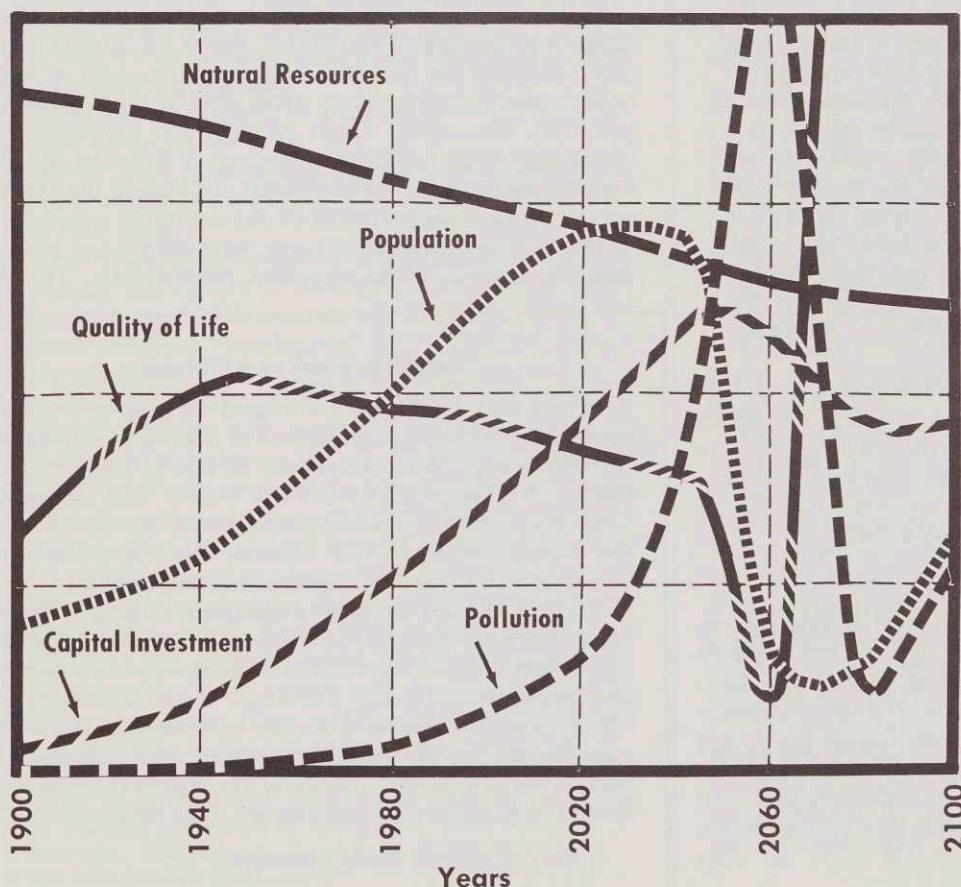
3. We may now be living in a “golden age” when, in spite of a widely acknowledged feeling of malaise, the quality of life is, on the average, higher than ever before in history and higher now than the future offers.

4. Exhortations and programs directed at population control may be inherently self-defeating. If population control begins to result, as hoped, in higher per capita food supply and material standard of living, these very improvements may relax the pressures and generate forces to trigger a resurgence of population growth.

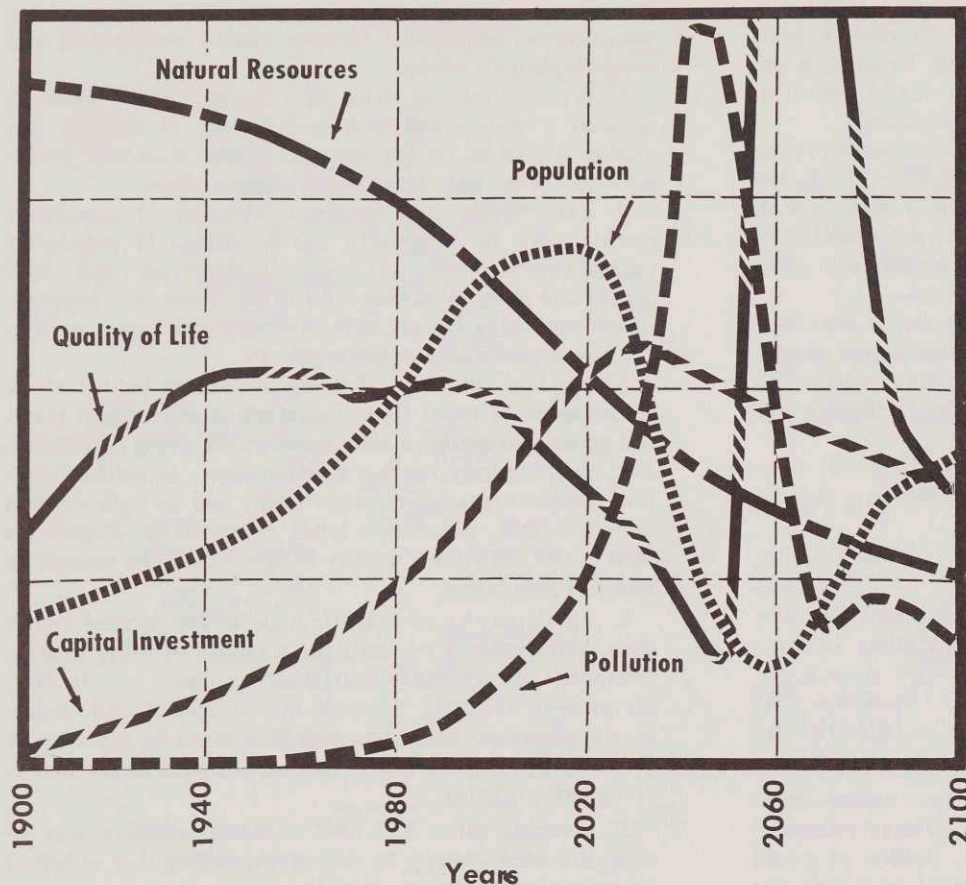
5. The high standard of living of modern industrial societies seems to result from a production of food and material goods that has been able to outrun the rising population. But, as agriculture reaches a space limit, as industrialization reaches a natural-resource limit, and as both reach a pollution limit, population tends to catch up. Population then grows until the “quality of life” falls far enough to stabilize population.

6. There may be no realistic hope of the present underdeveloped countries reaching the standard of living demonstrated by the present industrialized nations In fact, the present disparity between the developed and underdeveloped nations may be equalized as much by a decline in the developed countries as by an improvement in the underdeveloped countries.

7. A society with a high level of industrialization may be unsustainable. It may be self-extinguishing if it exhausts the natural resources on which it depends. . . .



In this simulation of world interactions, the Club of Rome researchers assumed that the usage of natural resources was reduced by 75% in 1970 through the application of more effective technology, without affecting the material standard of living. The computer projects that the level of world pollution eventually will skyrocket and population will plummet. Following this catastrophe, however, the quality of life would rise rapidly, reaching previously unknown heights.



The M.I.T. researchers wondered what would happen if in 1970 the rate of capital accumulation were increased by 20% in an effort to reverse the beginning decline in quality of life. This chart shows pollution rising rapidly, reaching a peak about the year 2050. Population peaks about the year 2010, then falls rapidly. Like the chart on the front cover, this simulation shows a decline in the quality of life as the world becomes more crowded and polluted—and an eventual collapse of population. After the collapse, however, the quality of life would again rise.

8. From the long view of a hundred years hence, the present efforts of underdeveloped countries to industrialize may be unwise. They may now be closer to an ultimate equilibrium with the environment than are the industrialized nations. The present underdeveloped countries may be in a better condition for surviving forthcoming world-wide environmental and economic pressures than are the advanced countries. If one of the several forces strong enough to cause a collapse of world population does arise, the underdeveloped countries might suffer far less than their share of the decline because economies with less organization, integration, and specialization are probably less vulnerable to disruption.

Despite the preliminary character of the model, it appears that further elaboration will not greatly affect the policy implications quoted above. Changing the values of the coefficients has little effect on the shape of thing to come—only on the time scale and sequence of events. Growth as we have known it will probably end very soon.

Some Ways the Model Might Be Improved

The World 2 model is at a very high level of aggregation. It suggests several ways future models of this kind might be improved. "Population" might be given an age structure. Renewable resources might be separated from nonrenewable resources and the possibility of substitution taken into account. Instead of having the effects of "pollution" increase smoothly with the density of contamination, the model might examine the complex effects that various mixes and distributions of contaminants might have on ecosystems.

In this model, "capital investment" assumes a constant allocation of capital to various forms of production. It might consider the effects of a massive diversion of capital to the reduction of resource usage and to the reduction of pollution. The model might consider the possibility that technology might enable the standard of living to rise while capital and resource usage actually decline as the result of a more efficient restructuring of our economic system.

The assumed relation between "crowding" and birth and death rates needs to be examined more closely. The stress

Social Dynamics as a Profession

"A new professional field is emerging—the profession of social dynamics. The intensity and duration of training for a practitioner in the field ought to be comparable to that in other major professions. Principles must be learned. Theory must be mastered. Cases that describe successful practice must be studied. Laboratory experiments in dynamic behavior must be performed. An internship must be served under experienced guidance.

"In 1971 no such complete professional training is yet available. Parts exist. But resources in people and money are limited. As the field of social dynamics becomes more widely recognized and supported, the quality and depth of educational programs will improve. Competence of trained professionals will rise. After educational programs have been created and men have been trained, we will better understand the dynamics of our social systems. With better understanding will come better societies."

Jay Forrester in *World Dynamics*

associated with crowding may depend less on population per unit area than on the frequency and character of interactions among individuals and groups, and this may in turn depend primarily on the structure of human settlements and transportation systems. It may be possible to structure cities so that large numbers of people could live in a small volume of space without excessive contact with one another. An approach of this kind is offered by architect Paolo Soleri (see his book, *Arcology: The City in the Image of Man*, M.I.T. Press, 1969).

A model of this kind needs to take into account the economic, political, and ethnic geography of the planet and the ways in which these forces are distributed. It is possible for the world economy to collapse as the result of instability in the international political or monetary systems, long before the limits imposed by resources and pollution are reached.

Mental Models Are Dangerous

Forrester grants that the World 2 model is oversimplified, but he contends that it is better than the mental models now being used for national and global planning. He emphasizes that there is no alternative to the use of some kind of model, and that the only question is whether we can improve on intuition.

Forrester considers the human mind to be excellent for discerning the structure of complex systems and the principles on which they operate, but very poor for deriving the implications of the assumptions it makes. He proposes that the human mind be used for what it does best—discerning the assumptions to be made—and that the computer be used to work out the implications of those assumptions.

Forrester identifies four traps into which intuition often falls:

- The attempt to relieve one set of symptoms is likely to produce more unpleasant symptoms.
- The attempt to produce short-term improvement often causes long-term degradation.
- The local goals of parts of a system often conflict with the goals of the larger system.
- Intuition often leads people to intervene at points in a system where little leverage exists and where expenditure will have little effect.

In the past, society has implicitly acknowledged that individual human intelligence is inadequate for solving large-scale social problems. We have come, rather, to depend on an assumed collective "intelligence" built into the structure of society and its institutions that is greater than the intelligence of any of its members. The adequacy of this collective "intelligence" to cope with very rapid change is now in doubt. It may be that during the years ahead decision systems whose principal components are human may prove fundamentally inadequate to cope with the problems we can create for ourselves, and so will have to be replaced by systems in which humans play a less critical role.

The M.I.T. group suggests that mankind is running a hopeless race in trying to keep ahead of the demands and pressures produced by exponential growth in population and industrial plant. The growth will eventually cease, no matter what we do, but if we understand our predicament and take appropriate action, we can avoid a catastrophe.

(*World Dynamics* by Jay W. Forrester. Wright-Allen Press, 238 Main Street, Cambridge, Massachusetts 02142. 142 pages. \$9.75. Forrester is Professor of Management, Sloan School of Management, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139. Reviewer Jon D. Roland received a B.S. in mathematics from the University of Chicago in 1967.

He has done research on artificial intelligence and self-organizing systems. Currently, he is active in various environmental and population organizations, and is one of the organizers of the Association for a Federal Union of Democratic Nations, which is now being formed. His address is 2853 Ontario Road N.W., Apartment 508, Washington, D.C. 20009.)

System Dynamics: Background of the Method

The method known as system dynamics has evolved at the Massachusetts Institute of Technology over the past 40 years.

In the 1930's, Vannevar Bush, a professor of electrical engineering, built a differential analyzer to solve the equations of certain simple engineering problems. The set of equations describing the problem was a *model* of the system they represented.

About the same time, another MIT professor, Norbert Wiener, was developing his concepts of feedback systems, and coined the term *cybernetics* to describe the emerging study of feedback systems. Still another MIT professor, Harold L. Hazen, was then at work on some of the first introductory papers in the field of feedback control, or servomechanisms. (the automatic control systems sometimes referred to as "robots" that are used to control certain industrial and military devices).

In the 1940's, Gordon S. Brown, an electrical engineering professor, created MIT's Servomechanisms Laboratory where the theory of feedback systems was developed and taught.

In the 1950's Jay Forrester served as director of the Digital Computer Laboratory and Division 6 of MIT's Lincoln Laboratory where digital computers were first used to simulate systems.

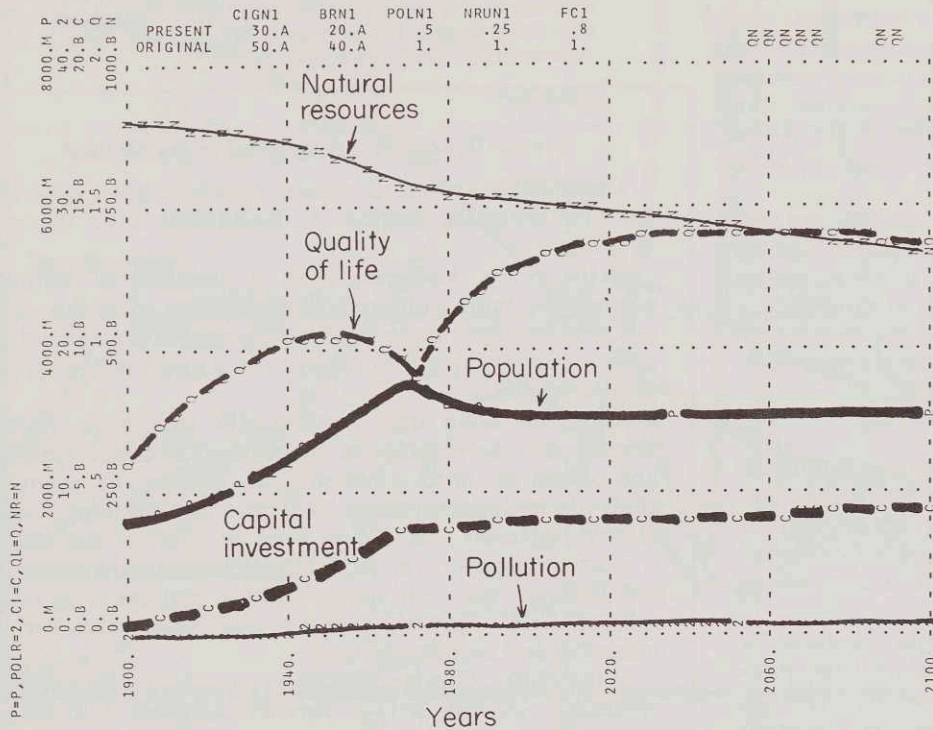
Beginning in 1956, Forrester and his associates at MIT's Sloan School of Management have extended the preceding developments to cope with the greater complexity of social systems. His books include *Industrial Dynamics* (MIT Press, 1961), *Principles of Systems* (Wright-Allen Press, Cambridge, Mass., 1968), *Urban Dynamics* (MIT Press, 1969), and *World Dynamics*, (Wright-Allen Press, 1971). These books document Forrester's progression from applying the systems dynamics method to business organizations, then to cities, and most recently to the entire world.

System Dynamics may be described as a method of computer simulation designed specifically to handle complex social systems. It can deal simultaneously with physical, social, and psychological variables, and it can handle nonlinear equations.

The method uses the human perceptions of the relationships that make up a complex system. Each of these relationships can be discussed by experts without the necessity for specialized mathematical language, and when they agree on what the relationship is, it can be represented mathematically in the instructions fed to the computer.

Once the information has gone into the computer, the computer can carry out a simulation—seeing, for example, how a 2% yearly gain in population will affect the total system over a period of years.

System Dynamics uses the human mind to do what humans can do best—recognize and analyze the separate elements in a social system—and the computer to do what a computer can do, but humans cannot—calculate the simultaneous operation of all these elements over a period of time.



This chart reveals a set of conditions that would establish a world equilibrium. The M.I.T. researchers assume in this projection that in 1970 the capital investment rate is reduced 40%, the birth rate is reduced by 50%, pollution generation is reduced by 50%, natural resource usage is reduced by 75%, and food production is reduced by 20%. This is a reproduction of one of the original charts prepared by the M.I.T. group.



Reviewer Jon D. Roland has done research in artificial intelligence and self-organizing systems. He currently is an activist in environmental and population organizations.

Should Cities Be Confined?

Last October Jay Forrester urged Congress to consider confining U.S. cities, rather than accepting the continued growth of the American population as pre-ordained.

Testifying before the House of Representatives' Sub-

committee on Urban Growth, Forrester challenged the tacit assumption that nothing could be done about the future population growth and therefore the task is to find cities in which the future population can live.

"Population generates pressure for urban growth," Forrester said, "but urban pressures help to limit population. Population grows until stresses rise far enough, which is to say that the quality of life falls far enough, to stop further increase. Everything we do to reduce those pressures causes the population to rise farther and faster and hastens the day when expediencies will no longer suffice."

If it were possible to prohibit the encroachment by housing and industry onto even a single additional acre of farm and forest, said Forrester, the resulting social pressures would hasten the day when the U.S. stabilizes its population.

"Some European countries are closer to realizing the necessity of curtailing urban growth than are we," he said. "As I understand it, farm land surrounding Copenhagen cannot be used for either residence or industry until the severest of pressures forces the government to rezone small additional parcels.

Forrester proposed that the Subcommittee on Urban Growth change its name to the Subcommittee on National Equilibrium.

"Our greatest challenge now is how to handle the transition from growth into equilibrium. Our society has behind it a thousand years of tradition that has encouraged and rewarded growth. The folklore and the success stories praise growth and expansion. But that is not the path of the future."

(Testimony for the Subcommittee on Urban Growth of the Committee on Banking and Currency, House of Representatives, Washington, D.C., October 7, 1970.)

Computers at the Crossroads

At the request of THE FUTURIST, free-lance writer Hazel Henderson went to the Massachusetts Institute of Technology for an extensive interview with Professor Dennis Meadows concerning the Club of Rome's Project on the Predicament of Mankind. In the following report, she puts the MIT group's work into the broad context of man's struggle to cope with our planet's complex, interacting social and natural systems. She begins with the irony that the best hope of assessing and controlling technology seems to lie in one of the most suspected technologies—the computer.

by Hazel Henderson

In the past year, the phrase "technology assessment" has entered the general lexicon of the American people, and one of the areas now receiving closest scrutiny is that of computers and information technology. Visions of abuses of these systems have been made credible to an increasing number of U.S. citizens through exposes of Government information—gathering on private citizens, credit bureau data banks, police use of television and computer surveillance and dozens of other chilling examples of abused civil liberties formerly conceived only in the realm of such fiction as George Orwell's *1984*.

The new fears are neither anti-intellectual nor neo-Luddite. They are expressions of a healthy, holistic concern that may help trigger a long-overdue debate on information technology and all its applications in society. Only through such debate can we produce the broadly-educated public opinion that will be needed to understand that computers are indispensable in managing the complex, interacting social systems and physical resources of our planet. The most ambitious attempt so far to simulate these interacting systems on a planetary scale is the project being conducted at the Systems Dynamics Laboratory of the Massachusetts Institute of Technology and described in this issue by its Director, Professor Dennis Meadows. If such vital projects as these are to be capable of influencing the course of human affairs, and to have any chance of averting the disaster implicit in current social policies, we must overcome both the current fears of the public and the inadequate understanding of their leaders concerning the computer. Only by squarely facing up to this public debate and making value judgements as to which computer applications are anti-democratic and oppressive, and which are humanizing and possibly even tools of survival, can we get them widely accepted as the basic hardware of public policy-making and social choice.

Before trying to understand and cope with the current anti-computer sentiment which now stands in the path of future applications, we should remember that whenever new technologies are introduced and diffused through society, their long-term effects are usually very different

from those intended. For instance, the automobile was hailed as an advance in individual mobility and a sanitary improvement over the horse, which polluted the streets. In a mere fifty years, use of the auto has polluted the air, changed morals and mores, exploded cities into vast suburbs while the inner cores became decayed and impassable, and paved over millions of acres of arable land.

None of these results was intended, and if current computer simulation techniques had been available, we might have predicted these effects well enough to forestall them. Other examples of the unintended side effects of new technology are legion: Detergents were developed to make dishes and clothes sparkle, but they also helped destroy once-sparkling lakes and rivers; pesticides created to control insects behaved as rampaging biocides when released into the environment. Obviously, what is needed is the development of large-scale models to predict technological costs and benefits, and to help us consciously decide when and where technology should be applied. We are slowly learning that we must consider the minuses as well as the pluses of a new technology if society is to obtain optimum benefits with minimum costs. Whenever an industry or government, attempts to apply a new technology without giving due attention to negative possibilities, a social backlash is almost inevitable. The public eventually discovers the side effects, either through direct experience or through rumor-mongers, alarmists, or demagogues. The result is likely to be a credibility gap.

Now it is the computer's turn, somewhat after the fact, to receive this kind of scrutiny. In 1946 it was thought that about 12 computers could manage all the information-processing work needed in the United States. Embarrassingly inadequate predictions like this illustrate well the "rear-view mirror" syndrome which Marshall McLuhan describes as the inability to view new technologies except in conceptually inappropriate terms of past images. The computer was seen as a glorified adding machine that would merely streamline the functioning of the existing industrial and mechanical order. McLuhan and other writers have pointed out some of the fundamental changes that computers are

making, such as, decentralizing decisions and institutions; including the consumer in the designing of products (through rapid feedback of his reactions), and by speeding up information flows to the point where action and reaction are almost simultaneous. Robert Theobald, the socio-economist and futurist, saw the inherent drive toward the link-up of information systems, and raised the specter of a cybernated economy where occupational employment would become less and less able to distribute purchasing power so that the goods coming off the automated mass-production lines could be consumed. Debate on this issue still rages. Sociologist Daniel Bell and others saw the creation of new human thought processes conforming to the needs of computerized systems, and the inadequacy of fragmented, linear thinking and learning patterns. Psychologists and philosophers worried about computers and the new metaphors, myths, and archetypes that they were creating: the robot man, man as a machine to be manipulated, the human brain as a computer, and all the dangers that these metaphors pose for man's self-image and dignity.

Frank and open discussion of all the implications of the new computer technology, as well as the more recent fears of data-banks operated by a "Big Brother" government would have made the computer's introduction much slower and more costly. But in the long run such a cautious approach might ensure the sounder application of both computers and other technology, with minimum disturbance of the social and economic system. The irony in the current controversy over computers is the fact that they are the best possible tools for monitoring or simulating the effects of questionable new technologies, as well as for helping manage the resources of our shrinking, polluted, over-populated planet.

Mental vs. Computer Models

There is nothing new or strange about the use of models to represent social systems, explains Jay Forrester in *World Dynamics*.

"Every person in his private life and in his community life uses models for decision making. The mental image of the world around one, carried in each individual's head, is a model. One does not have a family, a business, a city, a government, or a country in his head. He has only selected concepts and relationships which he uses to represent the real system. A mental image is a model. All of our decisions are taken on the basis of models. All of our laws are passed on the basis of models. All executive actions are taken on the basis of models. The question is not whether to use or ignore models. The question is only a choice between alternative models."

Mental models are fuzzy, incomplete, imprecisely stated. Furthermore, they change with time, even from moment to moment. During a conversation, two people may use fundamentally different models but never be aware of the differences, and when supposed agreement is reached, each may understand something different.

A computer model consists of a set of instructions that have been given to the computer. The model, in fact, consists of the set of descriptions that tell the computer how each part of the system acts. The model may say, for example, that when the birth rate increases, so will the population (other things being equal).

The model given to the computer is a simplification of an actual social system, but it can be far more comprehensive than the mental models that would otherwise be used as the basis for debating social policy.

One of the greatest contributions of Meadows' project for The Club of Rome is that it may dispel some of the dangerous myths and expectations of "abundance" and "progress." As Meadows remarked to me during my recent visit to M.I.T.'s Systems Dynamics Laboratory, "There is no utopia; we may have to content ourselves with the proposition that this period, with all its discontents may be, in fact, the 'golden age.'"

Ultimately, I hope that models developed by simulation groups will be exposed to wider and wider audiences, to decision makers of sub-systems further down in the hierarchies of scale, and eventually to individual voters in democracies via television "gaming" with instant computerized profiling of feedback from viewers. Some of these ideas are already being actively explored, notably by another group at M.I.T. under the direction of Chandler Stevens and Tom Sheridan. One project they now have under way is the development of a prototype system for the State of Massachusetts for citizen feedback and opinion formulation. Other projects geared to researching and developing technology for social decision making include the PLATO project at the University of Illinois (described by Stuart Umpleby and John Briggs in *THE FUTURIST*, December 1970) and the "Quality of Life" project conducted for the Puget Sound area of the state of Washington in 1970 to help citizens understand the environmental options open to them and to formulate goals for their community. Other researchers, such as sociologists Amitai Etzioni of New York City's Center for Policy Research, are using cable television and computers to link small opinion-developing "town meetings."

It is now imperative that the public come to understand the glorious potential of all these humanistic uses of computers and the need for widespread application of "artificial intelligence" to large-scale resource management and public policy formulation. The brightest of our computer specialists already understand this and are beginning to demand that computer systems be freed from mundane or anti-democratic uses so that they can serve in modelling society's big problems. New groups such as Computer People for Peace and magazines such as *Radical Software* proclaim their new concerns. These groups seem to share the understanding of many artists, writers and film-makers, that computers are a new art form—a way to perceive, organize, and structure reality—that may allow us to manage human affairs adequately enough to assure our survival. The "computers for the people" groups have built on the insight of nuclear physicist Leo Szilard who noted in 1929 that intelligent beings can intervene and decrease the entropy in physical systems. Some students of information technology believe that artificial computer intelligence can amplify the negentropic activity, and even perhaps eventually challenge the dismal Second Law of Thermodynamics! Other theorists such as John von Neumann and Oscar Morgenstern provided insights into gaming theory which helped make it possible to conceive of individual values and social choice as inputs to mathematical models.

Some of the underlying philosophical themes of today's young computer enthusiasts include the synthesizing of Eastern and Western modes of thought, the convergence of the age-old Cartesian split between mind and body, and a return to awareness of the integral nature of the system Earth.

Systems awareness, fostered by the computer and mass communications, also helped trigger the ecology boom,

The Counter-Intuitive Character of Social Systems

In his writings and lectures, Jay Forrester stresses that social systems are counter-intuitive—they don't work the way people think they should. In fact, the human mind is simply not built to understand the infinitely complex feedback patterns that characterize even a relatively small social system.

Some characteristics of social systems:

- Social systems are insensitive to most of the policies that people adopt in an effort to alter the behavior of a system. In fact, says Forrester, a social system tends to draw people's attention to the very points at which attempts to intervene will fail. For instance, a person observing human suffering in the cities notices that the poor people are living in inadequate housing, so he presses for more housing. When new low-income housing is built, more poor people are drawn into the area, because of the availability of cheap housing, but since low-income housing does not create jobs, more and more poor people are trapped in the depressed area, unable to get jobs because of the surplus of labor but too poor to live elsewhere.

- Social systems have a few sensitive "influence points" where pressure will change the system. But these influence points are not in the locations people think intuitively they should be, and if an influence point is shown to a person, his intuition is likely to lead him to press in the wrong direction.

Housing, says Forrester, seems to be a sensitive influence point for reviving the economy of a city, and making it a better place for both low-income and high-income people to live. But it appears that the way to move is to reduce rather than increase the amount of low-income housing. If more land is devoted to high-income housing, businesses, and other job-creating purposes, low-income people in a city can advance economically.

- In social systems, there is likely to be a fundamental conflict between the short-term and long-term consequences of a policy. Programs that produce improvement in five or ten years are likely to degrade the systems in the long-run. This fact is treacherous, says Forrester, because the short run is more visible and compelling. Nonetheless, "a series of actions all aimed at short-run improvement can eventually burden a system with long-run depressants so severe that even heroic short-run measures no longer suffice. Many of the problems which we face today are the eventual result of short-run measures taken as long as two or three decades ago."

(See "Counterintuitive Behavior of Social Systems," *Technology Review*, January 1971. Published by the Alumni Association of the Massachusetts Institute of Technology, Cambridge, Massachusetts 02139.)

Our Refractory Social Systems

Due to feedback, a social system quite typically behaves in ways that frustrate the person who wants to improve its operations. A few highly-simplified examples:

<i>Problem</i>	<i>Presumed Solution</i>	<i>What Happens</i>	<i>Final Result</i>
A road is overcrowded with cars.	Enlarge the road.	More drivers are attracted to the bigger road.	The new road is even more crowded than the old one.
Bus company is losing money.	Raise the fares.	Fewer people ride the buses.	The bus company loses more money than ever.
People in cities live in poverty.	Build houses and make them available at low rent for poor people.	More poor people move into the low-income area. Due to labor surplus in area, they can't get jobs, but are too poor to move.	More people in cities are living in poverty.
Air is polluted by burning of trash, such as old newspapers.	Campaign to get people to turn in their old newspapers for recycling.	Additional waste paper floods junk dealers, who reduce price paid for scrap. Price reduction causes regular junk dealers to abandon collections of scrap paper.	Air remains as polluted as ever.

(and, in turn, was reinforced by it). The systems ferment will soon produce a new set of theories in economics as well as its own system of ecological ethics and values. Economists are gingerly grappling with the implications of "zero population growth" and "the stationary state economy" first imagined by John Stuart Mill, and are exploring for the first time the "diseconomies of scale". George Harrar, President of the Rockefeller Foundation, expressed these new concerns at a Congressional hearing on the environment:

"America," said Harrar, "must now formulate a new environmental ethic that would de-emphasize such cherished industrial principles as economic growth based on constantly increasing production and consumption of goods. Morally, no society has the right to over-utilize the world's resources for its own contemporary and selfish interests."

Computers Can Help a Society to Formulate Its Values

Thus, computers have helped develop the new language and conceptual base of systems awareness and ecological perception. **Looking ahead, it seems likely that the greatest new breakthrough in understanding and application of information technology will be the realization that eventually computers will be capable of structuring and formulating the subjective values that we subscribe to as individuals and as a society.** This realization may be based on two premises: 1. **In a democratic society, individual subjective value judgments and decisions constitute hard data that can be fed back into models of social, economic or physical systems.** This vital insight was demonstrated clearly in Jay Forrester's three-dimensional model of the growth and decay cycle of an urban system, described in his book *Urban Dynamics*, (M.I.T. Press, 1969).

2. **Stable democratic political systems are operational models, incorporating the collective, subjective opinions of their individual citizens as to what constitutes "the good society."** By the same token, value changes in large groups of its citizens constitute feedback which modifies the system by changing its laws (i.e. program). For example, current changes in our subjective moral values are changing abortion laws all over the country. Indeed, we should remind ourselves that the subjective values of systems analysts routinely form inputs to current computer models; i.e. the values by which the analysts choose some data and reject others in structuring their models.

Furthermore, as Charles R. Dechert pointed out in *The Social Impact of Cybernetics* (Simon & Schuster, 1966), values are agreed-upon criteria for the operation of a system. For instance, the United States Constitution can be viewed as a program of agreed-upon criteria defining the nature of activities and interrelationships of its political system. According to Dechert's analogy, "The outputs of a political system are enforceable laws defining the interrelationships of persons and groups within the society . . . The executive branch puts the laws into effect and the judicial branch serves a control function by comparing specific individual actions with the law that programs such actions. Even judicial review in the United States is fundamentally a comparison of legislative action, (output) with a constitutional norm."

Define Moral Behavior by Mathematics?

Looking even further ahead, information systems may eventually be capable of formulating and quantifying moral behavior for Earthlings, by mathematical formulae. Before we dismiss such an idea as ridiculous, remember that we



Hazel Henderson believes that a computerized inventory of world resources might some day arbitrate disputes among nations.

know from quantum physics that the line which divides the physical and quantifiable from the metaphysical is an arbitrary invention of man. Reality is not split into neat, Cartesian dualities. Likewise, a workable morality for Earthmen may be developed from considering their needs and desires as conditioned by the quantifiable, physical limitations of their communal spaceship, the planet Earth. Moral behavior measured by such a formula would simply constitute those individual actions which did not extend beyond the relative share in available resources to which each person is entitled. In the "Survival Fairs" being staged on campuses, environmentalists and ecology students demonstrate the principle to each visitor by giving him a very small bowl of rice and telling him that, based on current population levels in the world, this is his rightful daily share of the world's resources.

Eventually, we may develop vast inventories of all the planet's finite, physical resources. If these were quantified, it might well be possible to divide the resources by the number of people, animals and other life forms they sustain, and thereby compute optimum population levels as goals to be achieved. Such a "world constitution", administered by a "world court of justice", sanctioned by world public opinion, might one day arbitrate between nation states or regions of the globe. Based on actual figures of how much of the planet's resources each human being was entitled to, it might be possible to compute the pro rata allotments of oil, copper, bauxite, or whatever, for each nation, or region, based on its population. Some gross estimates of this nature already are in use. For instance, we are constantly reminded by scientists and economists that the United States, with only 6% of the world's population, is consuming between 35 and 40% of the world's irreplaceable resources, and producing 50% of its pollution. These facts are used to warn us that this course of action must eventually bring us into conflict with the rest of humanity.

All of these speculations on the future applications of information technology await further theoretical analysis and development. They may seem too far into the future to concern average citizens. Indeed, pioneers like Forrester and Meadows are misunderstood and sometimes even condemned as technocrats. But the acceleration of change seems now to possess its own dynamic and waits for no man. **If we are ever to even hope for some measure of control over events, we need not only feedback but "feedforward". A full-scale national debate on the computer and all its applications may be the only way to assure that the ultimate beneficial capabilities of information technology will be put to solving what the Club of Rome rightly describes as "the predicament of mankind".**

(Hazel Henderson lives at 360 Rosedale Road, Princeton, New Jersey 08540.) She has published in *The Harvard Business Review*, *The Nation*, and other journals.)

Alternative Paths to World Order

Attempts to deal with global problems inevitably lead to the question of how the peoples of the world can best work together to solve their common problems. Aurelio Peccei, founder of the Club of Rome, urges a tight union of the Atlantic peoples and collaboration between the Atlantic Community and the Soviet bloc. Peccei's approach is one of several ways that have been proposed to achieve world order.

by Jon D. Roland

In his recent book, *The Chasm Ahead*, Italian industrialist Aurelio Peccei, founder of the Club of Rome, warns of an approaching "tidal wave of global problems" that threaten modern civilization and perhaps human survival: nuclear weapons, the population explosion, environmental degradation, resource depletion, under-education, growing poverty, rising expectations, and widening disparities among nations. He stresses that these problems cannot be solved by existing nations acting independently. Therefore, we must give first priority to developing the political institutions that the solutions require.

Peccei believes there are two "keys" to solving these global problems. The first is a union of the advanced open societies—the Atlantic Community and Japan.

"It is up to the Atlantic peoples, and only to them, to unite and take the lead in an unprecedented movement to face the future. Their leadership in thinking, in devising new approaches, and in action is indispensable for the world to solve its problems."

"The chasm ahead" that Peccei fears is the widening gap he foresees between America and the nations of Western Europe. He suggests that what is needed is for the U.S. to take the lead in the formation of an "Atlantic . . . federation."

"No constructive world design is possible," he says, "that is not the pursuit of an unreal stalemate, or diehard defense of precarious privileges and imbalances, unless the Atlantic peoples set an example to all other peoples and are themselves united in peaceful alliance, partnership, community, commonwealth, or some other form of mutual trust and cooperation. Only by acting in close concert can they influence other peoples and nations, the strong and the less strong, those who are friendly and in due time those who are not, and bring all of them sooner or later to their side with a fair chance to participate in, and benefit from, a cooperative effort toward resolving the world's problems."

The second key to solving these global problems, Peccei believes, is collaboration between the Atlantic community and the Soviet bloc. His view is similar to that of Zbigniew Brzezinski in *Between Two Ages: America's Role in the Technetronic Era* (see review in *THE FUTURIST*, December 1970). He argues that there is "no more room" between the East and West blocs for technological battles, cold war, potential confrontation, mutual hostility, reciprocal harassment and similar antagonistic postures.

"The altogether new era which is shaping up generates a formidable crop of problems that must be faced together by

jointly prospecting and planning the future," says Peccei. "The time has therefore come for us to decide, and to demonstrate to the Soviets that we want not to weaken but indeed to strengthen them, and make them our companions and world ally—of course, on certain conditions. These must be reasonable conditions and, again, ought to be dictated by an objective study and consideration of our planet's situation during the next decades."

Three Approaches to World Order

Peccei has proposed one design for world order. Most such designs can be classified as multinational, imperial, and federal.

Multinational designs contemplate the maintenance of peace through balance-of-power diplomacy and the containment of international conflict. Advocates of such designs usually foresee the eventual achievement within each of many independent nations of a high level of social and economic development, and the prevalence of democratic forms of government that would live in peace with one another. The model for this design is the situation that prevails among the advanced democratic nations today.

Imperial designs seek world order through the unilateral action of one dominant nation to establish a world state. Most modern nations are the product of imperial designs, and many of them are now developed and democratic. Such designs usually seek long-range order at the cost of short-range trauma and the loss of human freedoms. World order might be achieved this way, but modern weapons have become so dangerous that humanity might not survive the transition.

Federal designs seek world order through the voluntary co-operation of nations in the establishment of common institutions. There are two main approaches, the federal unionist and the world federalist.

The *federal unionist* design seeks eventual world federal union by first uniting a few nations and then getting others to join. Advocates of this design argue that to be effective and viable, a common institution must have exclusive power to govern in external and interstate affairs. It must have the power to make and enforce laws for and collect taxes from individuals, not just states. There must be a common citizenship for all persons born within its jurisdiction, a common legal system, and certain minimum personal rights guaranteed by law. Sovereign power must be exercised collectively by its citizens through frequent, open, competitive elections of its principal officials by secret ballot. Powers

not needed by the central or national government might be reserved to the people or to the states. Models for this design are such federal unions as Australia, Canada, the Federal Republic of Germany, Switzerland, and the United States.

Advocates of this design argue that federal union cannot be achieved by the gradual transfer of essential powers from constituent states to a common institution. The transfer must be a single, discrete act. Until that act occurs, a common institution cannot be expected to perform reliably the functions of an effective government.

To achieve federal union, this design calls for a convention of delegates from several nations that would draft a federal constitution for ratification by the peoples of those nations. The model for this is the Philadelphia Convention of 1787 that drafted the U.S. Constitution.

The *world federalist* design seeks world federal union through the establishment of institutions in which all nations participate and the gradual strengthening of those institutions until they constitute an adequate government, or at least until they are adequate to prevent world war.

Advocates of the two designs generally differ in how much power they think common institutions must exercise to be adequate. Federal unionists argue that there is no serious prospect that a world institution can acquire the powers needed to cope with world problems under the circumstances created by those problems. They argue that federal union cannot be achieved and would not work among states whose democratic institutions and traditions are not sufficiently developed. They point out that the U.S. Constitution would not have been proposed or ratified if universal participation and unanimous consent among all thirteen states had been demanded.

The current world federalist program includes various proposals to strengthen the United Nations, such as Charter review, a peacekeeping force, disarmament, and agencies for the management of the oceans, Antarctica, and outer space.

The current federal unionist program consists primarily of a resolution before the U.S. House of Representatives which would appoint a delegation of uninstructed U.S. citizens to meet in a convention with similar delegations from several other nations to discuss federal union. The resolution now has 111 cosponsors.

Such a resolution was adopted in 1960, and a convention held in 1962. The recommendations of the convention were referred to the U.S. State Department, which has taken no action on them.

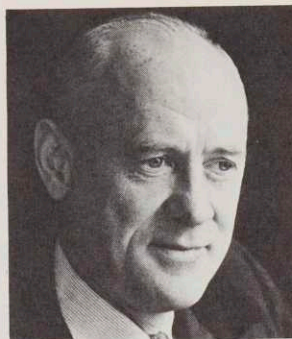
Peccei was unaware of the activity of the federal unionists when he wrote *The Chasm Ahead*. He is now a strong supporter of this approach.

Organizations representing the federal unionist design are the Association for a Federal Union of Democratic Nations, P.O. Box 4896, Washington, D.C. 20008, and Federal Union Inc., 1736 Columbia Road N.W., Washington, D.C. 20009.

Organizations representing the world federalist design are the World Association of World Federalists, 46 Elgin St., Ottawa 4, Canada, and World Federalists, U.S.A., 2029 K. St. N.W., Washington, D.C. 20006.

Other organizations representing similar views are the World Constitution and Parliament Association, 8800 W. 14 St., Denver, Colorado 80215, and the American Movement for World Government, Inc., Box 472, New Canaan, Conn. 06840.

(Jon D. Roland favors the federal unionist approach, but supports the other federal approaches as well. He lives at 2853 Ontario Road N.W., Washington, D.C. 20009. His telephone number is (202) 232-7948.)



*Clarence K. Streit is one of the best known advocates of the federal union approach to world unity. His books *Union Now* (1939) and *Union Now with Britain* (1941) were best-sellers. He now is president of *Federal Union, Inc.*, and editor of its journal, *Freedom & Union*.*

The Four Dimensions of Future-Oriented Thinking.

In Aurelio Peccei's view, the type of thinking that is needed if mankind is to survive the dangerous period ahead has four characteristics or dimensions:

The new thinking must be:

1. Systemic: We must be more fully aware that everything interacts with everything else in an interlocking series of systems. Monetary systems are but subsystems of the larger economic systems that condition them, and the apparently independent national economic systems are actually highly interdependent and constitute an international system. "Only by a holistic and system approach, and taking into account the feedback processes going on within and among all the systems and levels of this larger framework, can the external 'diseconomies' and the 'induced' problems that harass us be dealt with."

2. Global. Because of the growing number of problems arising from the world system, everyone's thinking must rise to ecumenical, global dimensions. Already certain key issues, such as economic development, security, communications, meteorology, the ocean regime, and the preservation of natural environments, have become so large as to cross over the antiquated political divisions of the planet, and therefore must be approached by global coordinated plans.

3. Diachronic. We must "live tomorrow today," because so many phenomena have long time lags before they become significant. "The question is not only to foresee or forecast far ahead in order to anticipate future trends or developments," says Peccei; "it really is to stop backing into the future. As today's predicament is largely rooted in yesterday's improvidence, present acts will to a great extent determine the situation even of distant futures. Thus short-term expediency would keep us permanently captive to the past and all but foreclose our options for the future. To adopt instead the long view—as far ahead as we can see—will teach us to arrange harmoniously in our views and plans all points of the temporal continuum in which we are going to live."

4. Normative: Our most pressing need, says Peccei, is normative thinking: We need to know where we are going, what our goals are. "The more we advance and the more we become conscious of our condition, the better we will perceive that the highest ranking capacity we have to develop is that of establishing feasible and worthy goals." Setting long-term global goals for mankind has become "the most essential function at this stage of human evolution."

Herman Cohn in Retrospect

A Parable for Futurists

Shortly after the turn of the century, a now forgotten futurist named Herman Cohn foresaw the problems that would be created by automobiles and mechanization of agriculture. Cohn was horrified by his own forecasts, but he remained optimistic. "Once our political leaders are told this story," he said confidently, "they will take the actions which are necessary to bring about a more palatable future."

by Harrison Brown

It has often been said that we cannot understand the future without first understanding the past. And so I would like to start by relating an obscure tale from American history.

The writings of one Herman Cohn, an early futurist, are not very well known, even to the specialist. Herman was science consultant to William Jennings Bryan during his 1908 campaign, and he was confident that one day he would be chairman of the President's Science Advisory Committee. Cohn had been hired by Bryan because of a misunderstanding which might well have resulted from poor hearing. When asked by Bryan whether Herman Cohn was a Fundamentalist, Cohn had replied, "Yes, I am fundamental." Bryan then said: "Young man, you are hired."

Following Bryan's final defeat, Herman Cohn drifted. For some time he headed a small not-for-profit corporation called Prediction, Inc., but his clients tended to be antagonized by his predictions. When he forecast the demise of the bustle, his one remaining client withdrew and the business failed. Eventually Herman fell into obscurity as Professor of Social Physics at Yale. He died a thin, malnourished, broken man.

Recently, when an old home in New Haven was torn down to make room for a parking lot, a bundle of Cohn's unpublished manuscripts was discovered. I have had the good fortune of examining some of these writings and I now understand why Herman was not very popular. For one thing, he was what we today would call a "Prophet of Doom." For another, unlike most futurists, he was supremely confident of his conclusions.

I will skip over a rather bulky essay written in 1908 entitled *On Nitroglycerine War*, which was obviously written to impress William Jennings Bryan with the importance of maintaining a strong defense establishment. I will also pass over other essays such as *The Decline and Fall of the British and French Empires*, *The Coming Russian Superstate* and *Will Railroads Become Obsolete?* None of these, incidentally, were accepted for publication. Instead, I would like to draw your attention to yet another rejected manuscript entitled *The Social and Political Consequences of the Internal Combustion Engine*, written in 1916, just 55 years ago.

In this essay, Herman Cohn agreed

with his fellow futurists of the day that the automobile was here to stay and that machines powered by gasoline engines would one day do virtually all of the work on the farms. **But whereas other futurists pointed only to the joyous aspects of this new development, Herman Cohn alone forecast trouble.** "I agree," he said, "that it would be pleasant to walk on streets free of animal waste products. But can we be sure that the waste products of the automobile will be an improvement?"

Cohn predicted that the attraction of the human being to the automobile would be irresistible. He discusses several aspects of human sensuousness and suggests that the automobile will eventually become what he calls a "societal position indicator," which I gather is what we today refer to as a "status symbol." He predicted that people would eventually reach the point where they would be willing to do virtually anything to acquire one. "So intense will their desires become," he suggests, "they will even be willing to forego bearing children, if by so doing they might hasten the day when one of these machines will be theirs alone." He concludes that we will eventually reach the point where



Author Harrison Brown tells the First General Assembly of the World Future Society about the obscure futurist Herman Cohn.

every adult in the nation will own an automobile.

With respect to the farm, Cohn points out that the attraction of the farmer to the tractor is equally irresistible, although in this case the attraction stems from strictly economic considerations rather than for reasons involving sensuousness or societal position indicators. He concludes that farm labor will eventually disappear from the earth scene.

Assuming the persistence of these two basic forces—the attraction between human and automobile and that between farmer and tractor—Herman Cohn then proceeds to develop what he calls “the sequence of events which I would be most likely to bet money on.” In this sequence, which today we call a scenario (There were no motion pictures at that time.), he describes the introduction of the automobile to the city, the struggle between automobile and horse, followed by the demise of the latter, the frantic attempts to adapt the city so as better to accommodate the automobile, the increasing congestion, the emergence of the parking lot, the freeway and the service station with restrooms.

Black Ghettos Foreseen

Cohn then turns his attention to the rural areas and asks, “What will happen to the labor force when the machines take over the farms?” He predicted that the displaced farm laborers would flock to the cities and he pointed out that being poor, they

could not just settle anywhere. Using the analogy of the 19th century wave of immigrants from Europe to the United States, he suggested that large ghetto areas would emerge and the skin complexion of the residents would be predominantly black. He suggested further that the newly-found mobility of the middle class would result in massive migration from the cities to the countryside where “they can live in comfortable homes, isolated from the depressing sights and sounds of poverty, ignorance, and violence.”

Herman Cohn predicted the rise and fall of effective public transportation systems and concluded, “Cities will become mixtures of office buildings, factories, parking areas, and highways, all imbedded in extensive black slums, which in turn will be surrounded at a safe distance by comfortable white residential areas.” He describes the sensitivity to disruption of a complex organism such as a city and concludes that the major cities in the United States are destined to cease functioning as the result of violence and disruption or as the result of prolonged disintegration or more likely both. “New York City,” Cohn wrote, “will grow to become a metropolis of more than ten million persons and will spread over three states. Manhattan Island will become a vast slum unfit for human habitation. Eventually the congestion, the filth and decay will combine with instability with respect to disruption, and the entire organism will cease to function.”

Cohn, who was obviously horrified by his own forecast, quickly pointed out that his conclusions were based simply upon an extrapolation of then-current trends. “Once our political leaders are told this story,” he said confidently, “they will take the actions which are necessary to bring about a more palatable future.” He clearly viewed the science and art of forecasting as a mechanism for bringing existing and potential societal problems to the attention of lawmakers.

The final paragraph of this essay is particularly revealing:

“Our political leaders at the city, county, state, and national levels are intelligent and practical persons who know how to get things done. Thus far their work has been confined almost entirely to the solution of critical current problems. It seems clear



Harrison Brown returns to his seat after addressing the World Future Society's Assembly last May 14. Applauding at right is John Gerba, General Chairman of the Assembly.

that they must now begin to devote time and energy to the solution of problems *before they actually become problems*. I am confident that once our leaders read these forecasts, they will take actions which are designed to forestall the predicted end result.”

This was Herman Cohn's final essay. Records indicate that he talked with many city councilmen, state legislators, and congressmen. The same records indicate that he became increasingly frustrated and depressed. In a letter written to one of his few friends he said, “They are always suspicious and on guard when I talk about possible happenings 50 or even 25 years from now. They look at me with some mild, even tolerant, amusement and smile as though to say, ‘You are interrupting my concentration on critical immediate problems.’ They take the attitude that the future is for those who live in the future to handle.”

Herman Cohn died shortly after he wrote those words.

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By now, I am sure that all of you realize that Herman Cohn is a fantasy. But he could easily have existed. And had he existed, he might well have forecast the events I have described. And had he forecast those events as I have described them, he might well have encountered the apathy and indifference I have attempted to picture.

Indeed, we can ask whether our leaders today are any more sensitive

to those societal problems which are created by technological change than they were in Herman Cohn's day. I doubt it. Such persons still permit their thoughts to be dominated by immediate problems. They move from one crisis to another, all of them rooted in actions which were taken by their counterparts 10, 20, 50 years ago. They still listen with some outward appearance of amusement when we speak about problems which might become critical 25 years from now as the result of actions taken today.

I need not emphasize that of all the characteristics of modern technological society, perhaps the most obvious and the most important is rapid change which is brought about by an unending sequence of technological innovations, which in turn have been brought about by the strong human desires to make money, to win wars, and to live longer. More often than not, these innovations have been introduced to our culture with little thought being given to long-term consequences. The concept of "laissez-faire" has been domi-

nant—let the future take care of itself. **Problems Must Be Solved in Advance**

As a result, we find humanity today confronted by an horrendous assemblage of critical problems—virtually all of which are interlocked. In addition to those enumerated by Herman Cohn, we are confronted by the problems of the cold war and the arms race, from which we have not yet been able to extricate ourselves, the problems of economic and social development of the poorer countries of the world, the problems of population growth and migration, the fantastically increasing demands upon the earth's resources. **I am personally convinced that these problems are soluble, at least from a purely technological point of view. But they are soluble only if we understand them in time perspective. Forecasting is, I believe, a key to our survival. We must learn to anticipate problems. We must understand problems before we can solve them.**

We are confronted with the major bottleneck of communication. It is useful for futurists to compare approaches and to talk about what the

future might be like. **But unless our conclusions and the reasoning that lies behind them are transmitted in understandable terms to our countrymen who vote and to those who make laws, all will be lost. Unfortunately, we have today in our own country a situation in which people generally and those who make our laws particularly have little contact with the scientific-technological community and with those elements of the intellectual community who are involved in attempts to examine the future.** This situation must be changed. It is essential that we learn how to secure the attention of people who make the kinds of decisions which will in the long run determine whether mankind survives or dies.

(The foregoing article is the text of Harrison Brown's address to the luncheon at the First General Assembly of the World Future Society, Washington, D.C., May 14, 1971. Brown is Professor of Geochemistry, California Institute of Technology, Pasadena, California 91109. His books, *The Challenge of Man's Future*, *The Next Hundred Years*, and *The Next Ninety Years*, are available from the Society's Book Service.)

Future U.S. Population Studied

Two recently published booklets urge the United States to adopt a national policy on population growth. They warn that the current leveling off of fertility rates may be but a temporary phenomenon. The booklets were issued by the Population Reference Bureau and the U.S. Commission on Population Growth and the American Future.

The Population Reference Bureau's booklet, *The Future Population of the United States*, relates the long history of shattered projections of future American populations of which the abandonment of the Census Bureau's high-fertility "Series A" is merely the most recent example. The bureau attributes the lowered U.S. birth rates during the 1960's to an actual changed preference for small families rather than to the oral contraceptive.

Immigration must not be disregarded if forecasts of future populations, the Bureau notes. A halt in net immigration into the U.S. now could mean 70,000,000 fewer Americans in 2020. The Bureau cites studies indicating the virtual impossibility of maintaining a constant Zero Population Growth over a period of time.

Reporting a study by demographer Tomas Frejka of the Population Council, the Bureau booklet says:

"To achieve an immediate cessation in the growth of the United States, the birth rate would have to be brought down from 17.6 per 1,000 per year to equal the death of 9.6 per 1,000 per year while all immigration stopped. Alternatively, immigration might be continued at its recent level of approximately 400,000 per year, in which case the birth rate would have to come down even more sharply."

A birth rate of 9.6 per 1,000 during a period when there

are unusually large number of women in the childbearing ages would have astonishing implications. Each family would have to limit its average number of children to a value of about 1.2 for the next 20 years or so, and thereafter the mean number of children per family would have to increase gradually reaching a maximum of 2.8 in the period 2030-2035. Completed family size would oscillate wildly with each generation.

The Commission on Population Growth and the American Future, chaired by John D. Rockefeller III, has published an interim report entitled *Population Growth & America's Future*. The report argues that it must become a national policy to promote sensible planning of families. It notes that during the early 1960s, nearly one-fifth of all U.S. babies were unwanted.

The Commission finds especially critical the decision by parents to have a third child. It notes that an average of three children in the family, though presently improbable, would bring the U.S. to a population of 300,000,000 by 1996 and 400,000,000 by 2014. In contrast, with each family averaging but two children, the U.S. would not reach the 300,000,000 mark until 2021—and would soon after level off.

(*The Future Population of the United States*, a 32 page booklet, constitutes the entirety of the February 1971 issue of the *Population Bulletin*. It is available from the Population Reference Bureau, Inc., 1775 Massachusetts Ave. N.W., Washington, D.C. 20036 for 50¢. *Population Growth & America's Future: An Interim Report Prepared by the Commission on Population Growth and the American Future*, a 49-page booklet, is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 for 40¢.)

Physico-chemical Control of the Mind

Electrical stimulation of the brain (ESB) and new drugs are enabling man to manipulate his own mood and mind. These powerful new techniques seem to some observers to foreshadow a monstrous world in which man has become an inhuman robot. But other observers believe that ESB and drugs can help create a more hopeful world in which man is freer, healthier, and happier than ever before.

by Henry Clark

Of all the many aspects of future shock which unsettle and intrigue us, none is more exciting—one might say “mind-blowing” or “electrifying” in a perfectly literal sense!—than the prospect of mind and mood manipulation through artificial means such as chemistry, psychosurgery and electric stimulation of the brain (ESB).

Scientific control of thoughts and behavior is becoming ever more possible—and some observers contend that it is also becoming increasingly necessary due to the growing complexity and interdependence of social relations and the ineffectiveness of alternative methods of enlightening the human mind or restraining anti-social actions. Other observers, more impressed by the potential for tyranny or dehumanization than by the possibilities for improved health and happiness, urge everyone who cares about the humanness of man to oppose the new technologies of behavior control with passionate conviction.

These issues are explored in three important new books by a brain physiologist, a psychiatrist, and an extraordinarily perceptive journalist. In *Physical Control of the Mind: Toward a Psychocivilized Society*, Jose Delgado of Yale gives a detailed account of the experiments with ESB which he has been conducting on animals and human subjects ever since the 1950s. Delgado attempts to work out a concept of the human mind which is both scientifically accurate and humanistically satisfying. Perry London, Professor of Psychology and Psychiatry at the University of Southern California (and a former Research Science Development Fellow of the National Institute of Mental Health), also deals with philosophical questions and clinical techniques in his work, *Behavior Control*, but his focus is broader than Delgado's in a double sense: He places artificial techniques in context by discussing the whole range of control technologies from magic and religion to penal servitude, and his normative concerns are legal and political rather than metaphysical or ethical. When supplemented by illustrative material from

Albert Rosenfeld's *The Second Genesis*, especially Rosenfeld's emphasis on chemical techniques as the ones which ultimately promise the greatest precision and potency, these books help to further a momentous debate which ought to be of the utmost interest to anyone concerned with future studies.

Powerful New Techniques of Behavior Control

As London reminds us, all kinds of information transmission are in some sense attempts to influence what others think and do. The promising and threatening thing about the new technologies of influence is that they are capable of becoming much more effective than the words, inflections, gestures and psychological or social pressures used heretofore by hucksters, teachers, preachers, demagogues, psychotherapists and leaders of sensitivity training groups. In London's typology, all of the aforementioned procedures, and even hypnosis, are forms of *control of information*, which he contrasts with *coercive control techniques* (physical incarceration or restraint, drugs and surgery). The line of distinction may be dubious, especially in light of Delgado's report that ESB **always** conquers the efforts of his patients to relay a different message to the part of their brain or body being affected by stimulation, but the main point is striking: All efforts to relieve undesirable symptoms or change behavior by giving a new insight are woefully imprecise and unpredictable in comparison to the technique of **action** therapy, which unapologetically seeks to manipulate the subject (or a part of his body) into **doing** something differently. London accuses most insight therapists of giving their clients “understanding” without relief of the symptoms they came to be cured of, and he maintains that even when ordinary insight therapy seems to be successful, the nature of its achievement is often unclear: The patient may have simply been persuaded to regard his symptoms as bearable, or he may have been given a subtle set of unconscious substitute rewards (e.g., the notion that he is much wiser and stronger than most other people because he has learned to recognize and live with his neuroses!).

“Action Therapy” Techniques: More Potent than Insight?

London claims that the following catalog of action therapy techniques have a lot more to offer than insight therapy:

(a) **counterconditioning**: “replacing one feeling or behavior with another antithetical to it.”

This may be accomplished by:

- o **discriminative training**, in which the patient is taught to distinguish non-threatening possibilities in something he fears and is given experience (leading to confidence) in realizing them;

- o **assertive training**, in which the patient is encouraged to do things he is normally afraid to do or to face things he is ordinarily afraid of;

- o **conditioned avoidance**, in which a patient gets rid of an unwanted behavior pattern by coming to associate it with pain (e.g., a disagreeable but harmless shock).

(b) **extinction**: “head-on attacks on problems rather than replacing old feelings with new ones.” Three techniques are recommended to achieve this end:

- o **reinforcement withdrawal** in cases “where the symptom is gratifying to the perpetrator”;

- o **systematic desensitization** in cases where the problem is anxiety;

- o **implosive therapy**, which endeavors to “create an internal explosion of anxiety, frightening the patient as much as possible without letting any actual harm come to him.”

(c) **behavior shaping**: an approach based on the work of Harvard psychologist B. F. Skinner which depends on

- o **reinforcement** and

- o **successful approximation**, in which “complicated behavior patterns, especially ‘skillful’ ones, are learned gradually, in small steps that come closer and closer to an optimal level of performance.”



Psychologist Perry London of the University of Southern California believes that therapists have a responsibility to manipulate their patients' behavior. London thinks that man's best defense against the dangers of behavior control is his power of self-awareness.

(d) **hypnosis**, a technique that is “the next generation of insight therapy” and is especially valuable for intensifying emotions or motivation.

(e) **conditioning**: an approach that establishes a new pattern of behavior, either by means of

- o **classical** conditioning, in which the subjects learn connections between logically unrelated signals and actions, or

- o **instrumental** conditioning, which links logically related causes and effects.

(f) **operant technology**; the final step in informational behavior control, in which “elegant teaching machines, elegantly controlled environment, computer therapy, information data banking, electronic bugging” and telemetric monitoring of bodily processes are included—but not ESB. These methods are separated from coercive measures in

Self-Stimulating Electrodes in the Future?

Experiments indicate that the human brain has pleasure centers, Albert Rosenfeld notes in *The Second Genesis*.

“Patients under ESB, sometimes without knowing that ESB had been applied at a given moment, suddenly said they were experiencing highly pleasurable sensations. ESB was able, at times, to turn depression to gaiety, and lethargy to alertness. Shy people became suddenly bright and talkative, and normally reserved women grew languorously flirtatious.”

Some of Dr. Robert G. Heath’s mental and epileptic patients have worn electrodes for long periods of time—electrodes they could themselves stimulate at will. This technique is called ICSS—for intracranial self-stimulation. ICSS devices have varied uses. A certain type of epileptic, for instance, feeling the first beginning sign of a convulsive seizure, can stop it instantly by pushing the button. A man afflicted with narcolepsy (chronic sleepiness) can stimulate himself into a state of wakefulness.

In one patient with severe narcolepsy, the method worked so well that “by virtue of his ability to control symptoms with the stimulator,” says Dr. Heath, “he was employed

part-time, while wearing the unit, as an entertainer in a night club.” This patient, like some others, had more than one button on his stimulator and had access to more than one area of his brain. He found that when he pushed one of the buttons “the feeling was ‘good’; it was as if he were building up to a sexual orgasm.” He pushed it frequently. So did another patient. On checking, Dr. Heath found that “regardless of his emotional state and the subject under discussion in the room,” stimulation in this area “was accompanied by the patient’s introduction of a sexual subject, usually with a broad grin. When questioned about this, he would say, ‘I don’t know why that came to mind—I just happened to think of it.’”

“One can easily imagine people in the future,” says Rosenfeld “wearing self-stimulating electrodes (it might even become the ‘in’ thing to do) which might render the wearer sexually potent at any time; that might put him to sleep or keep him awake, according to his need; that might curb his appetite if he wanted to lose weight; that might relieve him of pain; that might give him courage when he was fearful, or render him tranquil when he was enraged.”

Man the Machine

The most important idea about human nature attaching to behavior control technology is the notion that man is a machine. This does not mean that he ages, rusts, falls into disrepair, must be fueled, is difficult to maintain, hums, whirs, or goes chug-chug-chug, though many of these things are the case. Nor does it mean that he is merely a soft, warm computer, a lucky blend of inexpensive chemicals . . .

What it really means when we say that man is a machine is that his behavior is lawful and limited. This is true of everything else in the world as well, and its implications for understanding man are not new or special; but they are not always appreciated.

Perry London in *Behavior Control*

London's typology because they do "not deliberately alter the physical structure of the body in order to change behavior patterns." The logic of this distinction rests on London's conviction that "the techniques of control by information do not coerce the subject to comply and do the things required but leave some choice to him of how to act." London further supposes that "the alteration of structure is more frightening than the manipulation of information because it seems more permanent and more destructive of what we vaguely think of as our essential selves."

(g) "assault"; the infliction of pain by medical or penal personnel for the alleged rehabilitation of the victim, e.g., shock therapy. London does not recommend this form of behavior control, but his reasoning is not at all sentimental:

The enlightened modern view, which rejects corporeal punishment and physical pain as instruments either of healing or of social control, is not a by-product of changes in medical doctrine but of changes in medical technology, especially through chemistry, which made it unnecessary any longer to rationalize the uses of painful treatments in surgery.

(h) drugs.

(i) psychosurgery, including ESB.

Drugs and ESB offer Breakthrough in Behavior Control

The breakthrough in the technology of behavior control centers on the last two items in London's typology: drugs and psychosurgery (including electric stimulation of the brain).

Rosenfeld regards chemical techniques as more promising than ESB:

Anything ESB can do, chemistry can do better—once we learn how. At its best, ESB still requires the implantation of electrodes inside the brain and the cementing of sockets onto the skull, an exacting task whose end result is a relatively gross prodding of an area or site of the brain. Chemical control—interacting directly with the substances in the brain cells without physical molestation, without destruction of tissue, without the necessity for electrodes or sockets—is obviously the preferred method, and would provide much more precise control, not only triggering behavior, but modifying behavior as well, and modifying it virtually at will.

London agrees that the really exciting possibility offered by drugs is their potential answer to the "search for specificity." He states:

"The simpler, the more accessible the physiology and anatomy which underlies a class of behavior, and the narrower and more concrete the stimulus conditions which arouse it and the avenues of expressing it, the more likely it is that specific drugs can eventually be produced to control it."

Yet Rosenfeld has to admit that "the required sophistication is a long way off," and his speculations about the extent to which chemistry can augment mental powers such as memory and learning are viewed with skepticism by London, who asserts that pills will never be as good at eliciting specific behavior as they may come to be in inhibiting specific undesired behaviors. The most unarguable successes of chemical behavior control are in the grisly area of chemical and bacteriological warfare (CBW), where the question of resistance on moral grounds has a clear answer. London's discussion of tranquilizers leaves the impression that he regards factors of convenience (for doctors and nurses) profit (for manufacturers and druggists) and the touching faith of consumers—who often get spectacular results from placebos!—as more important than actual effectiveness in explaining their popularity.

ESB: Connecting Brain to Computer

On ESB, Delgado is the foremost authority. His ESB research is the latest milestone on a road that began with the classical experiments of Galvani, who showed that the legs of a decapitated frog contract in response to electrical stimulation." The necessary communication techniques with the brain were devised in the 1930s and perfected in the 1950s, when painless implantation of tiny "stimoeivers" in the brain enabled the experimenter to transmit and receive electrical impulses to and from the portion of the brain into which electrodes were implanted. Experiments carried out with a chimpanzee in 1969 proved that "direct communication can be established between brain and computer, circumventing normal sensory organs, and also that automatic learning is possible by feeding signals directly into specific neuronal structures without conscious participation."

The effects of ESB are remarkable. Not only is it possible to cause simple motor movements and certain complex movements (e.g., walking) in animals, it is possible to alter attitudes and moods so drastically that other animals perceive the difference in the "personality" of the one affected: the social hierarchy in a monkey colony can be upset when the normally belligerent ruler is rendered temporarily docile; indeed, the effect is so clear that lower-ranking monkeys can learn to depress the key that produces docility in the ruler! Comparable effects can be obtained in human subjects:



José Delgado of the Yale University School of Medicine says a new understanding of man is emerging from studies of his brain.

o postural changes and uncoordinated movements are easy to produce;

o some "well-oriented and apparently normal sequences" of movement can be elicited, and these are usually accompanied by the illusion of spontaneity in the mind of the subject, who explains what he is doing in terms of his own wishes or feelings;

o affection, anxiety, aggression, pleasure and their opposites can be aroused;

o and even hallucinations (lengthy musical pieces, clearly "played" and heard), recollections (including appropriate emotions and sensory memories) and illusions (especially that of *déjà vu*) can be created. Blind persons, for example, can be given "visual perceptions." But Delgado is careful to stipulate the limits of ESB. Even

motor responses are characterized by (1) lack of predictability on the initial stimulation, (2) lack of purpose, in the sense that "movements and sequential responses are usually out of context," and (3) the inability to create "robot performance." The desire for certain skills can be generated, but not the skills themselves. Above all, the fantasies of science fiction writers who envision "men with intracerebral electrodes engaged in all kinds of mischief under the perverse guidance of radio waves sent by some evil scientist," are quite impossible at present:

"We cannot modify political ideology, past history or national loyalties by electrical tickling of some secret areas of the brain," Delgado says. "A complete change in personality is beyond the theoretical and practical potential of ESB."

Delgado: Men Are Not Born Free, But May Become So

Physical control of the mind raises many questions concerning the nature of human freedom. Unlike Rousseau ("Man is born free, and everywhere he is in irons."), José Delgado maintains that men are not born free—but may achieve freedom.

Delgado spelled out his view at the 1969 Conference on Religion and the Future, sponsored by Crozer Theological Seminary and Lancaster Theological Seminary in cooperation with the World Future Society:

"Are human beings born free with the right to develop their own minds which should not be unduly influenced by parents or educators?"

"Should personal development follow natural tendencies without being inhibited or indoctrinated by artificial codes?"

"Does each individual possess a unique mind which is his private property, an essential part of his human dignity which must be respected as the source of personal feelings, memories, thoughts, and actions?"

"Is the individual entitled to independence in his behavior and the freedom to direct his own destiny?"

"Most of these questions are idealistic expressions of human rights, but they should be substantiated by supporting biological mechanisms, and if these do not exist, we may be dealing only with wishful thinking and false expectations. A clear case is the 'freedom of the newborn' which in reality is a misconception of his neuronal structure and capabilities. **Individual freedom is not a natural consequence of physiological development. It must be taught and exercised. If we take freedom for granted we may never enjoy it. If we recognize our initial lack of freedom, we may learn to take the necessary intelligent steps for its creation.**

Culture Shapes Newborn's Mind

"To analyze these ideas in more detail, we must recognize that personal identity is the result of the two classical groups of elements: heredity plus environmental information. The newborn has not the slightest intervention in the choice of these elements. Genes are provided by pure chance and cannot be selected by the parents or by their recipient. Human babies are born so immature and naive that they are totally dependent upon other people not only for their survival but for all information and experience. The question is not whether the newborn should, or should not be shaped, educated, and patterned, but who is going to provide the neces-

sary sensory inputs, what and how much information and experiences should be given, which techniques will be used, and which skills and behavioral reactions we would like to encourage or discourage. Language, beliefs, patterns of response, and many other elements will be acquired in some manner by the baby who cannot select any other cultural set. Children born in France speak French. Where is the newborn's freedom to develop his own mind? His waiting brain will store experiences provided by the environment which will be decisive for his cerebral development and for the structuring of his future personality. Ideologies, prejudices, and information are not invented by the individual but given to him from the immediate culture.

"It is true that we can choose not to structure the education of children, but then we are accepting that the sensory inputs provided by chance will be superior to any planning and purpose . . .

Cultural Design Could Promote Freedom

"Proponents of 'cultural design' such as B. F. Skinner, emphasize that behavioral engineering is a common practice even in the most democratic societies and involves the technologies of education, moral discourse and persuasion. 'Through a masterful piece of misrepresentation, the illusion is fostered that these procedures do not involve the control of behavior . . . but analysis . . . demonstrates a kind of control no less inexorable, though in some ways more acceptable, than the bully's threat of force.'

"Opponents of cultural design are concerned about the possible tyranny over men's minds, praising the virtues inherent in disorder which would be lacking in a well-controlled and excessively uniform culture. These objections could be relevant for a specific type of wrong planning, but they do not apply to cultural design in general, considering that if so desired, education could be directed to discourage tyranny, to increase disorder, or to promote diversity. The risks are not in the system, but in a possible misuse, as with most other human creations."

(The proceedings of the Conference on Religion and the Future are expected to be published in the coming months. The Conference's initiator was W. Kenneth Cauthen, now at the Center for Theological Studies, Rochester, New York. A report on the Conference appeared in the August 1970 issue of THE FUTURIST.)

Man's "Mind" and "Will" in the Light of ESB

Both Delgado and London are concerned about the philosophical presuppositions and implications of their research. Delgado undertakes to sketch a theory of mental processes that explains and justifies his experiments at Yale; London seems to assume the unarguable adequacy of the mechanical model of the mind which he espouses, and attacks any humanists who cling to "man's desperate wish" to imagine that he is more than his behavior or that he has meaningful freedom of the will.

For Delgado the "mind" is actually a process—"the intracerebral elaboration of extracerebral information"—which happens to be centered in the brain. The process may be thought of as involving a starter, an organizer and a performer, because there are identifiable portions of the brain that carry out each of these operations (each of which may be triggered by ESB). What we call the "will" is some kind of triggering event in the brain—an event which can be partially duplicated by ESB. But ESB can only trigger; it cannot "aim" an attitude or a movement, and it cannot determine what is thought or felt or done. The content of these brain "happenings" is programmed by the past experience of the person. Furthermore, Delgado argues that the mind does not exist apart from interaction with an environment. There is no such thing as "mind" (or "minds") as an isolated physiological entity, because the formation of mind requires cultural input in the form of human experience. An infant does not have a mind; he has "a mindless newborn brain" which is capable of developing into that center of intricate processes that is called "the mind."

ESB May Make Man Freer and Happier

Since the location of the part of the brain which produces a given type of behavior is nearly identical in most persons, it is possible that telemetering will someday enable brain technicians to inject a new input into a person's head through ESB, but at the present time all that can be done is to trigger the messages already there. Emotions or motivations can be intensified, but they cannot be created *ex nihilo*, nor can they be targeted. The effects that will be produced by stimulating a new portion of the brain cannot be reliably predicted. That is why, as noted above, Delgado does not fear Orwellian thought control, but is rather optimistic about the beneficial consequences of ESB:

By means of ESB we cannot substitute one personality for another, nor can we make a behaving robot of a human being. It is true that we can influence emotional reactivity, . . . but in each case the details of behavioral expression are related to an individual history which cannot be created by ESB. . .

We are now on the verge of a process of mental liberation and self-domination which is a continuation of our evolution . . . Its practical applications do not rely on direct cerebral manipulations but on . . . a *more intelligent education*, starting from the moment of birth and continuing throughout life, with the preconceived plan of escaping from the blind forces of chance and of influencing cerebral mechanisms and mental structure in order to create a future man with greater personal freedom and originality, a member of a psycho-civilized society, happier, less destructive, and better balanced than present man.

The Ethics of Personality Control

In *Physical Control of the Mind*, José Delgado presents this example of the dilemmas posed by behavior control through physical or chemical intervention in the brain:

In the early 1950s, a patient in a state mental hospital approached Dr. Hannibal Hamlin and me requesting help. She was an attractive 24-year-old woman of average intelligence and education who had a long record of arrests for disorderly conduct. She had been repeatedly involved in bar brawls in which she incited men to fight over her and had spent most of the preceding few years either in jail or in mental institutions. The patient expressed a strong desire as well as an inability to alter her conduct, and because psychiatric treatment had failed, she and her mother urgently requested that some kind of brain surgery be performed in order to control her disreputable, impulsive behavior. They asked specifically that electrodes be implanted to orient possible electrocoagulation of a limited cerebral area; and if that wasn't possible, they wanted lobotomy.

Medical knowledge and experience at that time could not ascertain whether ESB or the application of cerebral lesions could help to solve this patient's problem, and surgical intervention was therefore rejected. When this decision was explained, both the patient and her mother reacted with similar anxious comments, asking, "What is the future? Only jail or the hospital? Is there no hope?" This case revealed the limitations of therapy and the dilemma of possible behavioral control. Supposing that long-term stimulation of a determined brain structure could influence the tendencies of a patient to drink, flirt, and induce fights, would it be ethical to change her personal characteristics? People are changing their character by self-medication through hallucinogenic drugs, but do they have the right to demand that doctors administer treatment that will radically alter their behavior? What are the limits of individual rights and doctors' obligations?

As science seems to be approaching the possibility of controlling many aspects of behavior these questions must be answered.

Perry London goes a good deal further, both in his philosophical discussion of the mind and in his view of the ethical and political mandate that behavior controllers ought to assume they possess. "Skill at manipulation," he proclaims, "is not merely a useful tactic but a moral imperative." His confidence that the action therapists' "title to exercise control is as certain to them as their responsibility for healing is clear" is based on his conviction that man is "only his behavior," and that volitional freedom is illusory. To be sure, he concedes that man may be in some mysterious way something more than a machine, but he is not really interested in speculations on this point, because he considers them unnecessary, immaterial, irrelevant—and therefore probably a harmful obscurantism. The machine model tells us all we need to know about man, and on its assumptions we can control behavior, and that's what we really need to do to make life secure and good.

The only moral question man need ask is how to act. He can do this even with a material soul, even if there is no moral force in all the universe but himself, even if God is dead or never called on man to play some special role, and even knowing that freedom is, finally, the illusion of itself.

There is one kind of "freedom" that London cherishes,

though: it is the freedom of *awareness*, and informed choice (which will doubtless involve certain kinds of submission to certain types of "engineered consent" in the minds of individuals who see their need to be changed) is the key to the prime virtue of social responsibility. The danger associated with behavior technology "is that even its most benevolent use runs the risk of eroding freedom when it takes place by **the decision of anyone other than the person on whom it is used.**" Yet "in a free but complex society, that decision must sometimes be made by other people, and even against the subject's wishes." The only defense against misuse of behavior technology—our only hope for political freedom and justice in a technological age—is countervailing power, particularly the power of *awareness*:

The only defense against the intrusions of science and technology, the cohorts of massed knowledge, is to expand and fortify this consciousness of self, the armor of individual knowledge. The only deterrent or reply to behavior control is to increase [one's] technical mastery of his own behavior. Man's shield and buckler and, finally, his most potent weapon, is his individual power of awareness. It always has been.

Cultural and Political Implications

Many readers will probably find themselves very much troubled by London's view of man and its social implications, and even those who are intrigued by and fundamentally in agreement with his forthright appeal for more effective behavior control may be puzzled and dissatisfied by his recommendation of "awareness" as an adequate safeguard against tyranny. Fortunately, Delgado has a number of practical proposals to offer, and London hints at some guidelines for action.

London's prescriptions for societal health are neatly packaged in a rather glib formula that is merely thought-provoking rather than genuinely illuminating:

Of technology, it demands that individual development be maximized and people provided with the instruments of self-control; men must know their tools. Of politics, it demands that men be free and the machinery of government forever vulnerable to individual action against it; men must have their rights. Of free men, it demands that they be conscious of the need to share the world with other men and exercise restraint on their own willfulness; men must know some limits. Of society, it demands that it renounce coercion as its chief instrument of control and substitute persuasive means which individuals may finally take or leave, even at some peril to us all; men must take some risks.



Henry Clark, associate professor of religion at Duke University, thinks man should "keep his cool" in the face of new techniques of behavior control.

The Books discussed in this review are:

The Second Genesis: The Coming Control of Life by Albert Rosenfeld. Prentice-Hall. 327 pages. \$6.95. (Available from the World Future Society's Book Service). Contents:

Part I, The Refabrication of the Individual; Part II, The Exploration of Prenativity; Part III, Control of the Brain and Behavior.

Behavior Control by Perry London, Harper & Row. 241 pages. \$6.95. Contents: The Shaping of Man. 1. The Advent of Behavior Control. 2. The Emergence of Control Technology. The Tools of Mastery. 3. Control by Information (1): Psychotherapy. (2): Hypnosis, Conditioning and Electronic Tools. 5. Control by Coercion: Assault, Drugs, and Surgery. The Meaning of Behavior Control. 6. The Prospects for Behavior Control. 7. The Machine Model of Man. 8. The Ethics of Behavior Control.

Physical Control of the Mind: Toward a Psychocivilized Society by José M. R. Delgado, M.D. World Perspectives Series, Volume 41. Harper & Row. 281 pages. \$7.95. Sample chapters:

Methodology for Direct Communication with the Brain: Implantation of Electrodes in Animals; Electrodes in the Human Brain; Two-Way Radio Communication with the Brain.

Hell and Heaven Within the Brain: The Systems for Punishment and Reward: Perception of Suffering; Violence within the Brain; Anxiety, Fear and Violence Evoked by ESB in Man; Pleasurable Excitation of the Animal Brain; Human Pleasure Evoked by ESB; Friendliness and Increased Conversation under Electrical Control.

Electrical Activation of the "Will."

"Psychogenesis" is the word coined by Delgado to refer to the comprehensive program of education he wants to see undertaken in the psychocivilized society. It calls for "the use of available physiological, psychological, and psychiatric knowledge for the formation of the child's personality," and it arouses the hope that "symbols from the environment will be physically integrated within the brain as molecular changes in the neuronal structure." Psychogenesis will be neither authoritarian nor permissive, for "it is preferable to direct mental and behavioral development toward a self-determination of goals, knowing that if we want to create free individuals, we must teach them to be so." As a means of furthering this "direct intervention into the fate of man himself," Delgado proposes a kind of "NASA for the neurobehavioral sciences" which can develop the knowledge and organize the resources necessary for optimal exploitation of the new possibilities currently emerging.

The possibilities are staggering. The first reaction (or the continuing gut reaction!) of the individualistic humanist may be terror, and the panic it causes may lead to a ferocious determination to oppose artificial mind and mood manipulation before it becomes (as he fears it inevitably will) an uncontrollable monster. The socially oriented humanist, on the other hand, is in danger of being so enthusiastic about the healing, rehabilitating, edifying and pleasure-enhancing potentialities of the new technologies of control that he may underestimate their political and psychological perils. Perhaps the most important thing at this particular moment in history is the preservation of equanimity without complacency. If we succeed in "keeping our cool" on the subject, we may be able to work out the middle-range options that will enhance human knowledge, health and joy without sacrificing more freedom than justice and responsibility require.

(Henry B. Clark is Associate Professor of Religion, Duke University, Durham, North Carolina 27706.)

The Family in Search of a Future

Alternate Models for Moderns

The increase of divorce and non-marital sexuality has challenged the traditional institution of marriage. What might replace it? Fifteen experts offer provocative suggestions.

A Review by Ralph Hamil

The Family in Search of a Future, a new book edited by psychologist Herbert Otto, is a collection of proposed alternatives to the present, badly battered system of marriage.

Partly as a result of his own experience with divorce, Otto interviewed about 60 members of the professions concerned with marriage and divorce (a large percentage of whom had themselves been divorced).

His research revealed a great deal of dissatisfaction with marriage and divorce as presently institutionalized:

- "There was universal dissatisfaction with the divorce process, the legal complications and procedures, which were seen to be in great need of simplification and reform . . . Many questioned alimony payments for wives able to support themselves or having private means."

- "Joking reference was often made to the fact that, not too long ago, man was thought to be naturally monogamous. The extensive divorce rate and the widespread practice of extra-marital affairs, in addition to the Kinsey Report and a host of contemporary studies, call into question the appropriateness of a monogamous relationship in which husband and wife depend exclusively upon each other for sexual satisfaction."

- Mates often are chosen when the individual does not have the maturity and wisdom to make a good choice. Recognition of this fact, says Otto, has led to acceptance of a marriage-divorce-remarriage pattern.

- Partners expect too much of each other, and then are disappointed when their needs are not met.

- Recent research suggest that the advent of a child does not necessarily fulfill a marriage, but may be the first point of cleavage that separates husband and wife.

- About 30% to 40% of persons interviewed seemed to agree with Mervyn Cadwallader who wrote in "Changing Social Mores" (*Current*, 1967):

Contemporary marriage is a wretched institution. It spells the end of voluntary affection, of love freely given and joyously received. Beautiful romances are transmuted into dull marriages; eventually the relationship becomes constricting, corrosive, grinding and destructive. The beautiful love affair becomes a bitter contract.

In questioning the institution of marriage, says Otto, "we question indirectly the whole area of man-woman relatedness and the nature and quality of contemporary relationships between the sexes.

"Perhaps one of the clearest indications of the deep separation between the sexes is evidenced in the pattern of seat-

ing arrangements at most lay and professional meetings. Women tend to sit together, as do men. What appears to be in operation here is a combination of estrangement, mild anxiety, and hostility; sex stereotypes are in full bloom . . . Even in groups of married persons, women still seem to feel more comfortable clustering with other women and men more at ease with other men . . .

"A further index of the estrangement is that real friendship and understanding between the sexes is rare indeed. 'Man' relates to 'woman,' and not to the individual behind the image he has built. Each gender is so blinded by the sex image of the opposite that the person behind the mask rarely emerges from the shadows. The two images relate to each other—the persons remain strangers."

Against this background, Otto proposes that "we develop new forms of marriage and family which might conceivably add more warmth and intensity to human existence than we ever dreamed possible."

Following is a summary of some of the alternate models of marriage proposed by the authors that Otto has assembled:

"Progressive Monogamy" May Succeed Traditional Marriage

The current trend toward rapid remarriage after divorce or widowhood inspires New York University anthropologist Ethel Alpenfels to posit a totally new life style. Alpenfels suspects that what she calls "progressive monogamy" will prove the successor to the more traditional monogamous norms.

Once upon a time divorce was considered incompatible with the American Dream, and explained away as the escape for the very poor or the very rich, the rebel or the deviant. Today, Alpenfels writes, society must contend with "the inescapable fact that serial marriage is now practiced by all social classes, both sexes, and all ages."

Thus along with the rising incidence of divorce is an associated trend toward increasing popularity of marriage—and, recently, toward "progressive monogamy." Alpenfels' educated guess—one far less radical than most of those offered by her co-contributors—is that "progressive monogamy may very well prove to be an alternate structure for the familial system."

Legalize Polyandry and Tribal Marriage?

Harold Greenwald, a New York psychotherapist and author of *The Call Girl: A Social and Psychoanalytic Study*, questions the propensity of clinicians "to accept present-day institutions as sacrosanct and to see their primary task as adjusting the 'deviant' individual to the society in which he finds himself."

"Nowhere is the unquestioning and uncritical acceptance of the *status quo* more startling than in the field of marriage

and the family," writes Greenwald. He calls for an end to marriage as a state-regulated institution and its replacement with "non-legal voluntary association." Those who wish it would be permitted to seek "alleged security of state-certified marriage" but others would be free to try alternate forms, including polygamy, polyandry, and tribal marriage.

Should "Student Marriages" Be Institutionalized?

Anthropologist Margaret Mead presents her widely publicized proposal for two types of marriage.

"Student" or "individual marriage" would be a licensed union utilizing birth control and dissoluble at will. "Parental marriage" would be explicitly directed toward the founding of a family.

"Every parental marriage, at no matter what stage in life, would have to be preceded by an individual marriage," Mead proposes.

By "combining the best of our traditions and our best appraisal of human relations," Mead hopes, new forms of marriage may be created that will give dignity and grace to all men and women while ensuring that every child born will be wanted and prepared for.

"Intimate Networks" Proposed

Frederick Stoller, a professor in the School of Public Administration at the University of Southern California, proposes that "intimate networks of families" be established under professional counseling. Stoller notes:

"The increasing mobility of the American family creates greater isolation from the extended family—which results in a family experience that is not as rich, fulfilling, or creative as is possible. Limiting rather than enhancing, the isolated family tends to become more rigid and impoverished in terms of the influence, satisfaction, and ritual generated.

"An alternative structure is seen in the *intimate network of families*, in which three or four families come together on a regular basis to explore their living arrangements, to exchange intimacies, to provide services for one another, and to develop new and more realistic, and more exciting, systems of values and attitudes. Initial explorations or relationships between families have already been explored in family workshops and present a feasible base for introducing such a structure into American society."

Psychologist Calls For "Third Parent"

Carl Levett, a psychologist in White Plains, New York, argues that the absence of a father from the family while at factory or office creates a "vacuum of presence" leading to breakdowns in family and character integration unknown to old-time farm families. He offers as remedy the institution of "a 'third parent,' a male figure educated, trained, and equipped to serve the socializing needs of male children."

Levett concludes:

"With our present social milieu moving more toward the specialization of skills and talents, an acceptance of this condition can lead to a greater use of specialists to serve as alter-parents. Ultimately, a uniquely educated, trained, professional corps of alter-parents could help to overcome many parental deficiencies in future family models."

"Pairings" Might Be Legalized

John F. Cuber, a professor of sociology at Ohio State University, notes the discrepancy between the *de jure* concepts and *de facto* practice in sex and family relationships. Cuber proposes a four-point alternative system. "These alternatives," he claims, "are not so much visionary as they

What will destroy us is not change, but our inability to change—both as individuals and as a social system. It is only by welcoming innovation, experimentation, and change that a society based on man's capacity to love man can come into being.

Herbert Otto

are simple projections of *de facto* trends." The alternatives include:

1. The legalization of "pairings" of mature adults and teenagers and the uncomplicated dissolution of such pairings upon mutual consent.
2. The termination of the requirement that paired couples must share the same domicile. There would be greater participation by the state in child rearing.
3. Promiscuity and homosexuality would be permitted.
4. Restrictive legal codes would be overhauled.

"Marriage-Inventors" Might Develop New Ways to Cohabit

Sidney M. Jourard, Professor of Psychology at the University of Florida, espouses "serial polygamy to the same person," a relationship where two parties periodically alter situational roles.

After a marriage sours, says Jourard, there would be a period of estrangement, a period of experimentation, and a new, more meaningful remarriage to the same person.

He cautions that this model is only one of a myriad and suggests a new profession, that of "marriage-inventor." Such a professional would catalogue new ways for men and women to cohabit and raise children so that no one would be at a loss for new forms to try when the old forms had deadened.

Have Parties to Celebrate Loss of Virginity?

Family therapist Virginia Satir presents imaginative concepts for making marriage an exciting and fulfilling experience. Among her suggestions are:

1. Rearranging the business world so that fathers could spend more time at home. Men are essential, if children are to grow up as integrated people who have an intimate, real familiarity with both sexes.
2. Child birth should be witnessed by the father. Satir also would have the father room with the mother during the child's first two weeks.
3. Each phase of growth would be openly and obviously

Three-Year Marriages?

Two members of Maryland's House of Delegates have introduced a bill which would allow three-year contract marriages with the option to renew.

The bill's authors are Lena K. Lee and Hildagarde Boswell, both of Baltimore. Mrs. Boswell argues, "I'm quite sure the church won't like this but with the 18-year-old vote coming in, I think the youngsters will look upon this as a totally new approach toward marriage and a family situation."

(Associated Press dispatch, *New York Daily News*, February 26, 1971.)



Herbert Otto, author of The Family in Search of a Future, thinks that new forms of marriage might add warmth and intensity to human existence.

validated—perhaps the onset of menstruation for girls or the change of voice in a boy might be marked by a party. There might also be parties for the first step, first tooth, first day at school, first over-night visit with non-familial members, first date, first sexual intercourse, and “the first obvious and costly mistake.” (Mistakes, explains Satir, are “an inevitable part of risk-taking, which is an essential part of growth, and needs to be so understood.”)

“Human Potential” Seen as Basis for “New Marriage”

Herbert A. Otto, the book’s editor, is Chairman of the National Center for the Exploration of Human Potential in La Jolla, California, and in his own contribution, he presents a marriage model derived from the concepts of the human potential movement.

Partners in Otto’s “New Marriage” must both clearly acknowledge the personal relevance of the human potentialities hypothesis: that he or she is functioning at only a fraction of his potential. The marriage partners are also active participants in ongoing growth groups. They conceive of their own union as an evolving, developing, flexible institution and are interested in exploring its spiritual dimensions.

Group Sex—But Not Group Marriage—Viewed as Becoming More Common

Albert Ellis, the noted sexologist, doubts that group marriage is the wave of the future. He reminds us that history records many antecedents to today’s group marriages but very few, if any, have outlived the 30 years granted to the 19th century’s Oneida Community.

From his own long experience, study, and wide contacts, Ellis finds that “group marriages normally last from several months to a few years, and then seem to break up for one reason or another, particularly for nonsexual reasons. Thus some of the members of the cooperative will not work steadily at the jobs they are supposed to perform, or they will exhibit personality traits that are highly distasteful to some of the other group members. Hence a break-up will occur.”

Though he doubts that group marriage will ever attract more than a minority of people, he sees no reason why it should not be allowed for those who choose it. On the other hand, group sexuality—where three or more adults get together for mate-swapping and other plurisexual combinations—has increased greatly in the United States during the past decade, and Ellis expects the trend to continue.

Psychiatrist Joseph Downing holds up the tribal family of the hippies as a viable alternative to monogamous society. He styles such relationships as “a new Society of Awakening.”

Tribal families range in size from half a dozen to perhaps 50 persons. “A more definite roster cannot be given as there tend to be several dwelling places; it is difficult to tell an

acknowledged family member from a non-family member who is a close and intimate acquaintance. Also, there is an overlapping of tribal families so that a given individual may be a member of several families.”

Downing says that in an increasingly dissolving formal society, “we can expect more such informal group living arrangements.” He believes that the general American society would do well to support rather than suppress this subculture.

Return to Polygamy?

Edward Hobbs is a theologian and a lecturer in the philosophy of medicine who denies that monogamy is a theological absolute. Hobbs reminds the reader that the Hebrew patriarchs—Abraham, Jacob, David, and Solomon—had numerous wives. Recognizing that today’s concept of religion-sanctioned marriage is greatly changed from traditional norms, he suggests that pre-marital chastity no longer serves true religious values. He would also permit extra-marital sexual relations that utilize birth control.

A similar viewpoint is espoused by family counselor Gerhard Neubeck of the University of Minnesota, who marshals arguments and models for a revival of polygamy and polyandry. Unlike other polygamous societies, the one modeled by Neubeck is industrial. The subjects reside in separate households with two different spouses though they live in the same geographical area. Unfortunately, the model is undeveloped as neither children nor parents populate the scene.

Sex for Sexagenarians?

Geriatrician Victor Kassel would allow polygyny for sexagenarian men in order to compensate for the excess of women in that age group. He feels that polygyny after sixty offers a solution to the social problems and inability to cope that afflicts so many of today’s lonely aged. Improved diet, better living conditions, aid in case of illness, assistance with housework, health insurance benefits, and sex are offered as side benefits to the all-important problem of depression and loneliness of widows.

An opposite view is offered by Case Western Reserve University sociologist George Rosenberg who presents a detailed analysis of “the implications of the family for the aging population.”

Rosenberg cites a number of objections to a polygynous structure for the aged. These include the firmly implanted monogamous values of the modern female, and the disruption that polygyny would cause to the present kinship system, because assets would be redistributed outside the original family lineage.

(The Family in Search of a Future. Edited by Herbert A. Otto. Appleton-Century-Crofts, softcover, 204 pages. \$2.95. Contents: “Alternate Models from the Perspective of Sociology” by John F. Cuber; “An Alternate Model from a Theological Perspective” by Edward C. Hobbs; “Reinventing Marriage: The Perspective of a Psychologist” by Sidney M. Jourard; “Marriage as a Non-Legal Voluntary Association” by Harold Greenwald; “Marriage as a Human-Actualizing Contract” by Virginia Satir; “Progressive Monogamy: An Alternate Pattern?” by Ethel Alpenfels; “Marriage in Two Steps” by Margaret Mead; “Group Marriage: A Possible Alternative?” by Albert Ellis; “Polyandry and Polygyny: Viable Today?” by Gerhard Neubeck; “The New Marriage: Marriage as a Framework for Developing Personal Potential” by Herbert A. Otto; “The Tribal Family and the Society of Awakening” by Joseph J. Downing; “Polygyny after Sixty” by Victor Kassel; “The Intimate Network of Families as a New Structure” by Frederick H. Stoller; “A Parental Presence in Future Family Models” by Carl Levett, and “Implications of New Models of the Family for the Aging Population” by George Rosenberg.)

Dialectic Methods in Forecasting

"Counterplanning" is a method of challenging the world views that underlie planning and decision-making. This method can be used to force forecasters to examine the assumptions underlying their forecasts, and thus to lead them to make better forecasts.

by Frank L. Moreland

A basic task of decision-making is the exposition and evaluation of the assumptions or world view of the decision-maker, for one cannot evaluate a decision without evaluating its underlying assumptions. When we forecast, we make decisions, but we normally do not offer our assumptions to adequate criticism. Indeed, we do not have established means for doing so. I would like to suggest here, however, that dialectic methods can provide such a means.

In planning, the method of counterplanning is a radical form of the dialectic in which the data are transformed by different and convincing world views into deadly enemies, that is, conclusions (plans) that deny the validity of each other. In such a way, a decision maker may synthesize a better world view and, therefore, a better decision.

During the First General Assembly of the World Future Society, several speakers said that forecasters need to find ways to expose to criticism the assumptions underlying their forecasts. Social psychologist Donald N. Michael of the University of Michigan even said that a primary function of forecasting is to confront organizations with their assumptions. In a similar vein, Robert Jungk, the journalist and author, said that we must be mythbreakers. Both of these men feel that conflict will be required to do this, a conflict made up largely of the intellectual vested interest we have in secure, pat, and unexamined views of how the world works.

Let me begin with a real-world story:

Counterproposal Upsets Multi-Million-Dollar Decision

A little over three years ago, a large industrial corporation in the San Francisco Bay area made a tough, long-range decision, involving several hundred million dollars. Shortly thereafter, a doctoral candidate at Berkeley, Richard O. Mason, selected the study of that decision as his dissertation topic. A specialist in operations research and information science, Mason knew the company well, and was interested in the kind and manner of expert advice that the corporation executives used to reach their decision. Mason suspected that the corporation had some excellent opportunities that were systematically, but unconsciously, underplayed by both the experts and the decision-makers.

The decision that the executives had made committed the company to the development of overseas metal markets. That decision was final and the initial funds were committed at the time Mason began his study. But Mason had the full cooperation of the company in reviewing the decision on the condition that the company's name not be revealed.

Mason arranged for a mock, after-the-fact executive meeting to simulate what might have happened at the meeting in which the decision was made—if a different procedure had been followed. At the mock session, two proposals were to be presented. One would be the same proposal as before; the other, a strongly opposed alternative. The original plan may be viewed as a scenario, that is, it had a data base coupled to some forecasts of changes in that data, and a plausible story of how the company might interact with the world implied by those forecasts to yield a profitable corporate future. Actually, separating the original plan into these component parts proved to be an engaging and rather technical operation. Once it was accomplished, a counterproposal of a special kind was constructed. The counterproposal was special in that it was developed from the same data base and much the same data forecasts, as the original. However, the counterproposal was radically different from the already-agreed-upon proposal in the story it told about the future. The story in the counterproposal concluded that investment in a domestic rather than a foreign market was the best thing the corporation could do.

When these scenarios were presented to the mock executive session, a remarkable thing occurred: the meeting became real and the executives actually halted action on their previous decision. The executives were convinced that not only would they have to approach the decision anew but also that their ultimate decision would be the better for the conflict or debate style of decision-making. Months later the corporation adopted a strategy which was a blend of the two proposals. But why should this be so and what can this story from decision theory mean for futurists?

Counterplanning Traces Back to Kant's Philosophy

The intellectual tradition behind the contemporary theory of dialectical advice or counterplanning reaches back explicitly to Immanuel Kant two hundred years ago and in spirit at least back to Socrates. For example, much of the current work in management information systems has its roots in idealism, a philosophical direction that Kant contributed to.

An idealistic philosophy typically maintains that man plays a largely unconscious but active role in establishing

A Note on the Dialectic

The dialectic, a method of thinking developed by the German philosopher Hegel, pits an idea (thesis) against its opposite in order to generate a better idea.

Thesis + Antithesis = Synthesis

Author Moreland suggests that a similar technique can lead to better forecasts:

Forecast + Counterforecast = Revised Forecast

what he takes to be reality. He necessarily contributes something of himself to the construct before there can be any reality for him. One thing he contributes is his interpretation of how the world works, that is, his world view or *Weltanschauung*.

The world view is the model through which a person's data is interpreted. Information is its output, and that is why a person's world view is crucial to what he accepts as information. The world view of a decision-maker represents his assumptions about reality; it is that set of warrants or assumptions about how the world really works which he believes to be valid, even though he may not be conscious of them. They may be ingrained assumptions, like Kant's space and time. But a *weltanschauung* also includes a person's values and beliefs as well as what he accepts as factual knowledge. In Carl Jung's terms, the introverted person sees a world that is very different—but just as valid—as the world seen by the extrovert.

While saying that the *weltanschauung* interprets the data set, I do not mean to imply that the two are separable—far from it. **An example of a *weltanschauung* shaping the data set comes from events upon as at every turn today. For instance, up until fairly recently, most of us held the world view that nature was immense, immutable and obviously beyond our puny abuse of her; she was a sink and could absorb without notice the effects of man. Few of us even bothered to check these assumptions. We knew we had to be aware of her, but certainly not the other way around. So, with few exceptions, we did not collect data to see if we were affecting her.** Only when someone changed that world view, or had perplexing data that caused him to wonder, were we in a position to collect the data required to affirm the validity of the changed world view that most of us share today. World view and data, then, tend to support each other, because the data are collected on the basis of a world view.

Conflict Can Change World View

Individuals can and do change their world views to ones they feel are more satisfying or are somehow more "reasonable." But, such changes normally come from a situation of conflict in which the initial world view is challenged by another. The German philosopher Georg Hegel established a model for this process over a hundred years ago in his dialectic. In our terms, Hegel contended that an accepted world view, or thesis, continues on its course until a competing world view or anti-thesis presents itself to contest the future validity and viability of the conventional view. The contest resulted in a synthesis—a kind of mix of the two.

The synthesis is yet another statement about the world born out of the conflict of the first two statements; it is something new and something more than either of the other two. In the case of the executive committee of the West Coast corporation, the ultimate decision was a synthesis of the conflicting advice the executives had received. And, painful as the conflict and its resolution had been the committee later felt sure that a better decision was reached because of the dialectic.

The idea that better decisions can come out of convincing but conflicting advice is the basis of counterplanning. Counterplanning accepts the proposition that decision-making with respect to complex systems in a complex environment will always result in the development of undesirable and unforeseen consequences. However, counterplan-



Environmental planner Frank L. Moreland recommends the development of forecasts that are "deadly enemies" of each other.

ning goes on to say that such consequences are more due to our own limited perspectives than to any inherent malevolence of the future. Thus, in an effort to expand the perspective of the decision-maker, counterplanning pits conflicting, alternative plans against one another. One plan assumes the role of a thesis, and the other, an antithesis. However, in counterplanning, these conflicting plans are designed to take the strongest form of contradiction, that is, they are designed to be what C. West Churchman, professor of Business Administration at Berkeley, calls deadly enemies. Deadly enemies are stronger than the contraries of abstract logic, for they deny the validity of the world view of each other. They proceed from the source data base through different but convincing assumption sets to make conclusions that are mutually exclusive; they both cannot be true.

Mason's counterproposal, in our example, was a counterplan of this sort; one set of assumptions indicated that the company should develop domestic markets while the other said absolutely not, that foreign markets should be developed. Thus, our decision-making committee had its attention focused **not** on approval or disapproval of the plans, but rather on the evaluation of the assumptions underlying those plans, which is just what we have said we need to do.

To return to the question, "What can decision theory and information science tell us about making better forecasts," we conclude that the answer is that we should make our decisions with respect to forecasts within a situation of conflicting forecasts, preferably of the counterplanning sort.

I shall conclude by describing briefly a method for using a dialectic to generate forecasts. In this effort, counterforecasts are presented to panelists for synthesis, in a manner similar to the Delphi methods often used. In this method the panelists, or experts, evaluate the scenarios and recommend what they feel to be more reasonable ones. The originators of the Delphi might be surprised that a method which imposes forecasts on panelists in order to generate forecasts should be associated with the name Delphi; therefore, I have termed this method a Recursive Dialectic Forecasting Method. With it, the researcher begins with a plausible scenario; one which might have been generated by any of the traditional approaches. A deadly enemy counter scenario is then developed. As was said before, this is accomplished in a process which is quite technical but which still remains largely judgmental. In it one analyzes the initial forecasts into a data bank, its forecast changes and a world view. Then the world view is analyzed into the partitions or aspects of reality recognized by it, and the comments or assumptions it makes with respect to those aspects.

If possible, the counterforecast accepts as given the original data bank, though often it is impossible to proceed without enlarging the data bank, because the counter-world view may wish to consider different determinants than the first. Normally, convincing deadly enemies can be constructed from the initial data bank alone, and the process is

neater if that is the case. The crucial part of the counterforecast development phase is the construction of a reasonable but different set of assumptions, and this part must remain largely based on intuition and judgment. From these different assumptions will come a world view which says that the event originally forecast cannot occur because a different, explicitly-stated event will come instead.

The scenarios may be put into a variety of written formats for use by the panelists. After the panelists study the scenarios, they come to a judgment of what they think might actually occur. For instance, a panelist may say one complete forecast is likely to the exclusion of the other, or he may decide on a blend of the two, or he may feel some important determinants have been omitted and insist that they be included. Whatever his decision, each panelist records his thoughts and returns that record to the experimenters.

The experimenters then face a most difficult, vague and questionable part of their work, that is, the compilation of the decisions of their respondents into a small set of counterforecasts. Once the counterforecasts are developed, they are again formatted and distributed to the panelists. Depending on how divergent are the thoughts of the panelists, one may continue this process through several stages, each time recursively developing the next stage out of the end state of the previous one. In the final stage, confidence estimates are made by panelists with respect to the counterforecasts presented to them. Following the recent work of Norman Dalkey at the Rand Corporation, it would be well to include self-competence ratings by the panelists.

Aggregates of these results are then compiled and a variety of presentations are possible. Naturally, we would prefer a minimum of two strongly opposed deadly enemies as the final product.

There are two basic reasons for suggesting that counterforecasting be used. The first comes from the experiences of each of us when we find ourselves falling in love with our own ideas or scenarios. That is, we know that we need criticism to keep us honest and to keep our eyes open. The second reason comes from decision theory, information science, and philosophy: Each of us has on blinders that we are not even aware of; We hold to world views with assumptions that we have never questioned. Those assumptions can only be tested by exposing them to a radical debate, and one way to provide that debate is by counterplanning and counterforecasting.

(The foregoing paper was presented to the "Games Futurists Play: Scenario Building" session at the First General Assembly of the World Future Society, Washington, D.C., May 13, 1971. Moreland is Assistant Professor of Environmental Planning, Division of Man-Environment Relations, College of Human Development, Pennsylvania State University, University Park, Pennsylvania 16802.)

Harvard Phases Out Its Program on Science and Technology

A sizable grant from IBM in 1964 allowed Harvard University to establish a Program on Technology and Society for the purposes of undertaking "an inquiry in depth into the effects of technological change on the economy, on public policies, and on the character of the society, as well as into the reciprocal effects of social progress on the nature, dimension, and directions of scientific and technological developments." The Program, directed by Emmanuel G. Mesthene, has to date issued six annual reports summarizing its research activities and publications. Much of the Program's output was intrinsically future-oriented.

In response to the recommendations of an external committee, however, the President of Harvard University has decided that the Program should be related more directly to the teaching needs of the University. Accordingly, the Program in its present form is to be terminated at the end of the 1971-72 academic year. The balance of funds remaining from the original pledge will be used to create new teaching posts in the existing departments and faculties concerned with technology and society.

A final report from the Program will be issued and distributed in Spring 1972.

(The Program's headquarters are at 61 Kirkland Street, Cambridge, Massachusetts 02138.)

News of Local Chapters

North Carolina: Prof. Robert D. Dahlke, Marketing Economics, N. S. State University at Raleigh, has taken over as coordinator for the Raleigh-Durham-Chapel Hill "research triangle." He succeeds Prof. Robert A. Rupen of Chapel Hill and hopes to get a local program going this fall. One possibility is a student symposium on the future.

Seattle: After serving as coordinator for the past two years, Prof. J. B. Schneider of the Department of Civil Engineering, University of Washington, is turning his responsibilities over to Tom Sine of Seattle Pacific College, now a doctoral student at the university. Tom represented the Seattle group at the General Assembly in May and told us he was interested not only in the future, but in "transitional strategies" to make progress toward long-range goals.

Long Island, New York: Wesley M. Thomas, who lives at East Northport, N.Y., is contacting other members on Long Island (we have about 130 altogether) with the idea of getting some sort of local group under way, with professional and social programs. His special interest is in computer applications.

Milwaukee: Prospects appear promising for our 150-odd Wisconsin members to organize some sort of local or regional group and program. Stanley J. Matek, executive director of the Mental Health Planning Committee of Milwaukee (whose address is on Watertown Plank Road, and doesn't sound terribly futuristic in this day of modern high-speed freeways!), has undertaken to try to organize a local committee. At the Assembly in May, we introduced Stan to Earl Joseph, who has done such an outstanding job with the Minnesota Futurists, as an ideal adviser on organizational procedures.

Houston: We don't yet have an organized group in Southeast Texas but continue to receive expressions of interest from Houston, one of America's most dynamic cities. It was good to see Don Kelly of Beaumont, who started the North Texas chapter before his recent transfer, at the Assembly.

Hawaii: A Hawaii chapter has been organized with Richard J. Barber of Honolulu as coordinator. Several members of this chapter attended the Assembly in Washington and told us that a big future-planning program is under way for the Fiftieth State, in which WFS members may perhaps hope to play some part.

Rhode Island: L. W. Davies of 9 Gertrude Avenue, Rumford, R.I. 02916 has offered to circularize members in Rhode Island and nearby Massachusetts to see if there is interest in some kind of group meeting in that area. We were able to provide him with about 30 names of WFS members.

Cincinnati: A separate group of the World Future Society has been formed by the Cincinnati chapter for activities on the University of Cincinnati campus. Fred C. Orth III, who heads this new group, tells us that only persons connected with the university are allowed to operate on its premises. A design engineer, Fred says that he is interested in "sensitizing" students to problems and prospects of the future.

Pittsburgh: James C. Williams, Pittsburgh coordinator, reported at the General Assembly that a May 25 meeting was scheduled at which reports would be made on impressions and experiences of those who attended in Washington. This was to be the third meeting of the Pittsburgh group, which hopes to meet again in the fall and discuss selected topics from Peter F. Drucker's book, *The Age of Discontinuity*.

Kansas City: The Society has about 50 members in the Kansas City area. Frank Hopkins is prepared to provide a membership list to the member who spoke to him at the Assembly about organizing a local group but whose name has been misplaced. This is another dynamic community interested in planning for the future.

Switzerland: Reginald Kazanjian, a retired American Foreign Service officer living in Geneva, writes that he is equipping an office in that city with books and periodicals on the future which may be consulted by transient members of the World Future Society. His address is Boite Postale 255 (Gare Cornavin) and he will provide further information later.

Tulsa: Ray Bell's very active group in Oklahoma concluded its spring program with a meeting at which local clergymen were asked to talk on ethical implications of population planning, particularly the concept of zero population growth.

Washington, D.C.: The Washington chapter at a dinner meeting in late May reviewed the impressions of members on the Assembly program, and discussed ideas for a second Assembly (or possibly a series of regional assemblies) to be held in the future. The Washington chapter will begin its fall program in August with a luncheon meeting at which Edward Kelty of the National Institutes of Health will talk on the future prospects for an improved national health-care program. The chapter now has 225 paid-up members, out of the approximately 600 Society members living in the greater Washington area.

Local Groups and Coordinators

For information about local activities please contact the persons listed below. If there is no one listed for your area and you would be willing to help organize activities, please contact: Frank Snowden Hopkins, Coordinator of Chapter Activities, 5108 Lawton Drive, Washington, D.C. 20016. Telephone: (202) 229-1519.

Canada

ONTARIO

Toronto: Committee officers—F. D. Barrett, chairman; G. Pielsticker, vice chairman; Klaus Schwarzkopf, secretary. For information contact: F. D. Barrett, Management Concepts, Scarborough. Telephone: 264-3010.

Ottawa: Peter H. Aykroyd at 996-2333 (office) or 234-2211 (home) or Bob Boase, Bureau of Management Consulting, at 996-5300 (office) or 238-2404 (home).

QUEBEC

Montreal: John G. McGraw at Loyola of Montreal.

Ireland

Dublin: E. N. Murphy, Department of Chemical Engineering, University College.

Israel

Haifa: Jehuda Abraham, Industries Development Corp. Tel. 244411/2/3

Sweden

Stockholm: Tibor Hottovy, National Swedish Institute for Building Research, Box 27 163, Stockholm 27.

United States

ALABAMA

Montgomery: William T. Gay. Telephone: (205) 264-0500.

CALIFORNIA

Los Angeles: Chapter officers: Robert W. Prehoda, president, Rosabel Brown, vice president; Dail Neugarten, secretary; Robert Wicks, treasurer. For information: Al Kazanowski at (213) 346-7466 (home) or 594-3487.

San Diego: Chapter officers: Jack Mahan, president; Paul Athan, vice president; Glenn Erickson, corresponding secretary; Dorothy Weaver, recording secretary; Richard Jones, treasurer; Marilyn Lees, program chairman. For information, contact: Dorothy Weaver, 926 Muirlands Vista Way, La Jolla. Telephone: (714) 454-6300.

San Francisco: Chairman: Peter L. Shoup, Pacific House, 360 Bryant St., Palo Alto; Vice Chairman: John R. Gayle, Stanford Research Institute, Menlo Park; Treasurer: Maryjane Dunstan, Larkspur; Secretary: David C. Miller, Pacific House. For information, telephone: Shoup or Miller at (415) 328-8064, or Dunstan at (415) 924-6193.

COLORADO

Denver-Colorado Springs: Charles Padden of Littleton. Telephone: (303) 789-1952.

CONNECTICUT

Hartford: Committee: Jay S. Mendell (233-3576), Jean Gosselin, Elliott Frauen-glass (666-5554), Jere Clark.

DISTRICT OF COLUMBIA

Washington: Chapter officers: Denis Johnston, president; John Fondersmith, vice president; Richard Brennan, secretary; Frank Hopkins, Marlene Futterman, Miriam Kelty, Gregg Edwards, Vary Coates, David P. Snyder, council members. For information: Frank Hopkins (5108 Lawton Drive, Washington, D.C. 20015; Telephone: 229-1519).

GEORGIA

Atlanta: Chapter officers—H. Oliver Welch, president; Frank J. Clarke, vice president; Diane D. Stephenson, secretary; Anthony A. Amato, treasurer; James Gates, Harry Adley, and Ed Benson, directors. Committees: Joe Celko (public affairs); James Green (membership); Jack Seay (program); Andrew Steiner (goals); Arnoll Connell (evaluation). For information: H. Oliver Welch at 524-1521.

HAWAII

Honolulu: Richard J. Barber, Chapter coordinator, 1914 University Avenue, Apt. 101, Honolulu 96822.

ILLINOIS

Chicago: Gerald Bay, Tech Utilization Center, IIT Research Institute, 10 West 35th St., Chicago, Ill. 60616.

INDIANA

Indianapolis: John D. Borah, New Cities Inc. (317) 636-4337.

IOWA

Indianola: Donald H. Koontz, Assistant to the President, Simpson College.

KANSAS

Lawrence: George M. Beal, Apt.-N208 Regency Place, Lawrence 66044.

LOUISIANA

New Orleans: Dr. Irving A. Fosberg, Psychological Service Center, Office phone: (504) 866-1794.

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The Connecticut and Western Massachusetts Chapter is listed under Connecticut.

Lowell: Dr. William S. Harrison, Department of Social Sciences, Lowell Technological Institute.

MICHIGAN

Detroit: Peter Fisher, General Motors, Home 342-3006. Office: 556-4446.

Kalamazoo: Merl C. Hokenstad, Jr., Director, Western Michigan School of Social Work.

MINNESOTA

Minneapolis-St. Paul: Chapter officers—Earl C. Joseph, president; William L. Bergen, vice president; Dale O. Johnson, secretary. For information contact: Earl Joseph (Univac, St. Paul) at (Area code 612) 645-8511 ext. 3425.

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Buffalo: James A. Duran, Jr. Telephone: home—(716) 731-3644 (Sanborn, N.Y. exchange); office: 883-7000 ext. 247.

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New York City: Brian N. Quickstad. Telephone: (212) YU 6-2515

Syracuse: James M. Oswald at Maxwell School, Syracuse University

NORTH CAROLINA

Raleigh-Durham-Chapel Hill: Prof. Robert D. Dahlke, Marketing Economics, N.C. State University, Box 5576, Raleigh, N.C. 27607.

OHIO

Cincinnati: Frank Morgan, 10150 Beech Lane. Telephone: 771-0543 (home) or 738-1111 (office).

Dayton: Thomas L. Mantel, National Cash Register Co., Kettering. Home: 859-4672; office: 449-6745.

Toledo: W. D. Lieder, Sun Oil Co., Toledo. Home: (419) 536-3644.

OKLAHOMA

Tulsa: Ray Bell of Pan American Petroleum.

PENNSYLVANIA

Harrisburg: Dean Richard H. Heindel, Pennsylvania State University, Capitol Campus, Middletown. Telephone: (717) 787-7728.

Philadelphia: A. J. Pennington, Drexel Institute of Technology (215) 387-2400, ext. 661.

Pittsburgh: James C. Williams, 1310 Woodlawn Avenue, Pittsburgh, Pa. 15221. Telephone (412) 731-4699.

State College: Manfred Kroger, 107 Borland Lab., University Park, Pa. 16802. Tel. 865-5444.

PUERTO RICO

San Juan: Dr. George H. Dorion, Director of Advance Projects, Barcardi Corp., G.P.O. Box 3549, San Juan, P.R. 00936.

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Memphis: May Maury Harding, Southwestern at Memphis. Telephone: (901) 274-6606.

TEXAS

Beaumont: Don Kelly, 1135 Alabama, Apt. #29.

Dallas-Ft. Worth: Dan Schores, Austin College. Telephone: Office—892-9101 ext. 372; home—892-2284.

Houston: Dale W. Steffes, Panhandle Eastern Pipeline Co., Box 1642, Houston. Tel. (713) 664-3401, Ext. 309.

North Texas: Prof. Daniel Schores, Austin College, Sherman 75094. Tel. Office: 892-9010; Home 892-2284.

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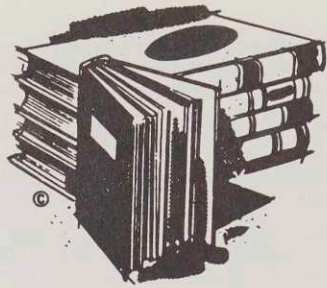
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Cultural Futurology Symposium: Pre-Conference Volume. Produced for a meeting of the 1970 American Anthropological Association. 369 pages. Contains contributions by Magoroh Maruyama, Elise Boulding, Margaret Mead, Roger Wescott, James Dator, and others. Paper with spiral binding. **\$7.50**

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Supplemental Program, World Future Society
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Washington, D.C. 20036, U.S.A.

I would like to participate in the Supplemental Program.

Enclosed is a check for my first year's **additional** dues (\$10 in U.S. Funds).

(Persons who are not already members of the Society should send a check for \$17.50.)

Name _____

Address _____

Telephone _____

Title and/or profession _____

GENERAL—VARIOUS

The Future of the Future by John McHale. George Braziller, 1969. 322 pages. 80 illustrations. Reviewed in *THE FUTURIST*, October 1969. **\$7.95**

History and Futurology by Ossip K. Flechtheim. Verlag Anton Hain, Meisenheim am Glan, Germany. 1966. Foreword by Robert Jungk. 126 pages. Paperback. Reviewed in *THE FUTURIST*, February 1968. "The portion dealing with futurology should interest most futurists." **\$3.35**

The Year 2000: A Framework for Speculation on the Next 33 Years. By Herman Kahn and Anthony J. Wiener with contributions by other staff members of the Hudson Institute. 431 pages. Macmillan, 1967. Review in *THE FUTURIST*, February 1968. **\$9.95**

The Challenge of Man's Future by Harrison Brown. Viking. 290 pages. "Dated (1954) but solid and still pertinent. Emphasizes population, food, energy sources." Paperback. **\$1.65**

The Next Hundred Years by Harrison Brown, James Bonner, and John Weir. Viking, 1957. 193 pages. Caltech scientists discuss food, industrialization, technical manpower in prospect for coming decades. "Published in 1957, but the problems are still with us." (Price includes 25 cents for handling.) **\$1.70**

The Next Generation by Donald N. Michael. Vintage, 1965. 218 pages. Paperback. "Sober attempt to foresee what young people will face during the next 20 years." Review in *THE FUTURIST*, August 1967. **\$1.65**

The Meaning of the 20th Century by Kenneth E. Boulding. Harper Colophon Books, 1964. Paperback 199 pages. A view of man's social evolution including possible dangers of overpopulation, war, exhaustion of mineral resources and "entropy." Review in *THE FUTURIST*, August 1967. (Includes 25 cents for handling.) **\$1.70**

GOALS

The Prometheus Project: Mankind's Search for Long-Range Goals by Gerald Feinberg. Doubleday Anchor, 1969. 264 pages. A Columbia University physicist proposes that the human race consider where it wants to go and what it wants to become. "An intriguing proposal. Lucidly written." Paperback. **\$1.45**

Toward Balanced Growth: Quantity with Quality. U.S. Government Printing Office. 228 pages. Paperback. 1970. Report of the White House's National Goals Research Staff. Review in *THE FUTURIST*, August 1970. (Price includes 15 cents for handling.) **\$1.65**

GENERAL—RECOMMENDED FOR NEWCOMERS

Here Comes Tomorrow: Living and Working in the Year 2000 by the Staff of the *Wall Street Journal*. Dow Jones, 1966. Paperback. 196 pages. Based on interviews with various experts, the book looks at the future of population, food, computers, energy, air travel, space, communications, automobiles, cities, homes, medicine, education, and war. "A good job of journalism." **\$1.85**

The Dynamics of Change by Don Fabun. Prentice-Hall, 1967. 190 pages. This puts a cover around the 1966 Kaiser Aluminum News series on the next 20 years. "This is a lavishly illustrated book that will go nicely on a coffee table." Paperback. **\$4.95**

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To join, a prospective member should submit his name, address, and occupation and a check for his first year's dues (\$7.50) to the Membership Committee (World Future Society, P.O. Box 19285, Washington, D.C. 20036.)

NOMINATION FOR MEMBERSHIP

I believe the following persons would be interested in membership in the World Future Society. Please send them information and application forms.

Name _____ Name _____

Address _____ Address _____

City _____ State _____ City _____ State _____

Additional names and addresses may be listed on a separate sheet of paper.

My name is _____

Address _____

City _____ State _____

If you wish to make this a gift membership, simply check this box and enclose payment (\$7.50 for one year in U.S.; \$8 in Canada; \$8.50 elsewhere). A gift announcement will be sent if you indicate here how the card should be signed. **FROM:** _____

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The Next Ninety Years: Proceedings of a Conference Held at the California Institute of Technology, March 1967. In this paperback, Caltech professors Harrison Brown, James Bonner and John Weir review the book they had written 10 years earlier (*The Next Hundred Years*) and discuss their forecasts in the light of subsequent developments. 186 pages. California Institute of Technology. (Includes handling charge) **\$4.45**

Innovations: Scientific, Technological and Social by Dennis Gabor. Oxford University Press, London. 1970. 113 pages. Physicist Gabor, author of *Inventing the Future*, lists 137 prospective inventions and innovations and expresses his opinion concerning their desirability. **\$4.95**

The Moral Society: A Rational Alternative to Death by John David Garcia. Julian Press, New York. 1971. 355 pages. This volume offers a synthesis unifying ethics, science, technology, evolution, and socio-political action. **\$8.95**

Managing Complexity: Work, Technology and Human Relations by James C. Stephens. University Press, Washington, D.C., 1970. 450 pages. Guidance from a future-oriented management expert. **\$9.00**

Where the Winds Sleep: Man's Future on the Moon—a Projected History by Neil P. Ruzic. Foreword by Wernher von Braun. Doubleday, 1970. 236 pages. Ruzic argues that the moon's apparent advantages may encourage colonization and presents a time table. **\$5.95**

The Shape of Minds to Come by John G. Taylor. Weybright and Talley. New York. 1971. 278 pages. Taylor describes how science is making it possible for man to raise his intelligence, control his emotions, remember forgotten material, etc. **\$6.95**

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2. To advance responsible and serious investigation of the future.
3. To promote the development and improvement of methodologies for the study of the future.
4. To increase public understanding of future-oriented activities and studies.
5. To facilitate communication and cooperation among organizations and individuals interested in studying or planning for the future.

Programs: Besides publishing a journal, **THE FUTURIST**, the Society offers its members a variety of other programs:

- **Lectures and Seminars:** Local groups are active in a growing number of cities. These groups offer lectures, seminars, and other opportunities for face-to-face meetings.

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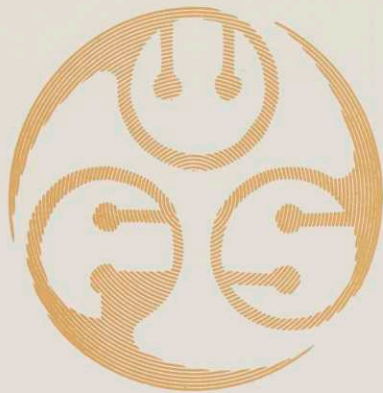
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Institutional Members of the World Future Society

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Western Metal Products Co., Cocoa, Florida, John A.
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World Institute Council, New York, N.Y., Julius Stulman.

Institutional Membership: The Society now offers a special membership to institutions—research institutes, business concerns, government agencies, associations, and other organizations—wishing to participate more fully in its activities.

Privileges of Institutional Membership include:

1. An individual membership for the person in the institution who receives the materials and otherwise provides liaison between his organization and the Society.

2. Participation in the Supplemental Program. (This includes the **WORLD FUTURE SOCIETY BULLETIN**, advisories concerning documents available from the Document Depository, and Select Papers (scientific papers, bibliographies, reports, etc.)

3. Any books, reports or studies published by the Society.

4. Certain special documents (books, reports, articles, etc.) chosen by the staff as potentially of interest to a particular Institutional Member.

5. Query service. An Institutional Member may request information from the Society. No charge is made for handling inquiries that do not require substantial staff time. Inquiries must come from the person providing liaison with the Society.

6. Documents. An Institutional Member may request documents from the Society's Document Depository, and these are provided free of charge, up to a maximum of 150 pages of documents.

7. Professional Contacts. The Society's staff will seek to assist institutional members in locating sources of information, consultants, employees, etc.

8. Promotional benefits. Institutional members may be listed in Society publications. They may also be given, from time to time, special opportunities to report on their future-oriented activities through the Society's publications.

9. Courtesies. Institutional members are entitled to special courtesies at the Society's General Assembly and at other Society functions.

10. Other benefits may be extended to institutional members whenever reasonable and appropriate.

How to Apply for Institutional Membership: Application should take the form of a letter to the Society's Institutional Membership Committee. This letter should be on the letterhead of the organization desiring membership and should include the following information: 1) The mailing address and telephone number of the organization. 2) The name and title of the person to whom materials should be sent. 3) The individual or department to whom dues notices should be sent (if different from the foregoing). 4) Special needs or interests of the organization. Dues are \$100 a year.

Patronage: The Society's progress is due in large measure to those members who have voluntarily contributed their time and money. Since the Internal Revenue Service recognizes the Society as a nonprofit, tax-exempt organization, U.S. citizens may deduct gifts on their tax returns.

The Society appreciates all gifts, of whatever size, as an earnest of the dedication of our membership. Persons giving \$100 or more are deemed Patrons of the Society. The following categories of patronage are recognized: Founder, \$1,000; Sponsor, \$500; Supporter, \$100.