

3. Delays in the negative feedback signals arise for two reasons. First, some delays, such as those inherent in population aging, pollution transfers, and land fertility regeneration, are inescapable consequences of physical or biological laws. Second, some delays are caused by the time intervals necessary for society to perceive new environmental situations and to adjust its values, institutions, and technologies in response.

A system that possesses these three characteristics—rapid growth, environmental limits, and feedback delays—is inherently unstable. Because the rapid growth persists while the feedback signals that oppose it are delayed, the physical system can temporarily expand well beyond its ultimately sustainable limits. During this period of overshoot, the short-term efforts required to maintain the excess population and capital are especially likely to erode or deplete the resource base. The environmental carrying capacity may be so diminished that it can support only a much smaller population and lower material standard of living than would have been possible before the overshoot. The result is an uncontrollable decline to lower levels of population and capital.

With this understanding of the system characteristics that lead to instability, it becomes relatively easy to evaluate alternative policies for increasing stability and bringing about a sustainable equilibrium. For example:

1. Short-term technologies designed to mask the initial signals of impending limits and to promote further growth will not be effective in the long term. Rather, they will disguise the need for social value change, lengthen the system's response delays, and increase the probability, the speed, and the magnitude of the eventual overshoot and collapse.
2. Policies that combat the erosion of the earth's resource base will certainly reduce the severity of decline after an overshoot. However, so long as growth is still emphasized and feedback delays persist, resource conservation will not in itself prevent overshoot. Furthermore, the overstressed system may not be able to afford the costs of conservation during a period of overshoot.
3. Social value changes that reduce the forces causing growth, institutional innovations that raise the rate of technological or social adaptation, and long-term forecasting methods that shorten feedback delays may be very effective in reducing system instability.
4. A judicious combination of policies designed to prevent the erosion of resources, foresee the effects of approaching limits, and bring a deliberate end to material and demographic growth can circumvent the overshoot model altogether and lead to a sustainable equilibrium.

Although these conclusions seem to be simple and self-evident, most economic and political decisions made today are based implicitly on a world view very different from the one presented here. The dominant contemporary model contains the assumptions that physical growth can and should continue; that technology and the price system can eliminate scarcities with little delay; that the resource base can be expanded but never reduced; that the solution of short-term problems will yield desirable long-term results; and that population and capital, if they must ever stabilize, will

do so automatically and at an optimal level.

The world views implicit in World3 and the mental model underlying most current decisions are diametrically opposed in their policy implications. World3 identifies basic instabilities in the socioeconomic system and suggests that significant changes in social institutions and values are necessary to avoid collapse. Current policy models are based on the assumption that the requisite stabilizing mechanisms do already exist and that no future events will necessitate more than minor adjustments in current policies. Selection of the wrong model as the basis for growth policy would drastically reduce society's long-term options, but the choice cannot be avoided. It is implicit in every policy or action that has long-term influences on population or capital growth.

Unfortunately, there is no straightforward, objective process to prove conclusively that one social model is correct and another is false. Instead, every person must examine the assumptions underlying each model and then base his decisions on the one he finds most consistent with his own knowledge of the world. The process of establishing confidence in any social model is always difficult and uncertain. The debate over which policies should guide growth will continue for at least several decades. Much remains to be done to clarify that debate and to guide it to an informed and satisfactory conclusion.

## 8.2 THE STEPS AHEAD

Advocates of a world view that is different from the one presented here would enhance future discussions greatly if they would express their theory as a formal model, so that persons in various fields could personally scrutinize its assumptions and independently determine its implications. As Jay W. Forrester suggested in the Preface to his volume on World2:

It is to be hoped that those who believe they already have some different model that is more valid will present it in the same explicit detail, so that its assumptions and consequences can be examined and compared. To reject this model because of its shortcomings without offering concrete and tangible alternatives would be equivalent to asking that time be stopped.

It seems traditional for explicit models of social systems to be greeted by vague criticisms about their lack of perfection. Instead, we need equally explicit alternatives with a demonstration that the alternative leads to a *different* and *more plausible* set of conclusions. By proposal and counter proposition our understanding of social systems can advance. [Forrester, *World Dynamics*]

Those who agree with the basic concepts expressed in World3 can go on to test, improve, and disaggregate the model and to use it where appropriate as a basis for policy in local, regional, or national systems. However, since World3 was formulated to provide global perspectives, it can supply only general guidance for short-term, local policies. The same characteristics of growth, limits, delays, and erodable resources that make World3 unstable also produce instability in subregions of the globe. But the understanding that will provide concrete regional plans for reaching sustainable equilibria can come only from more specific, detailed models made in