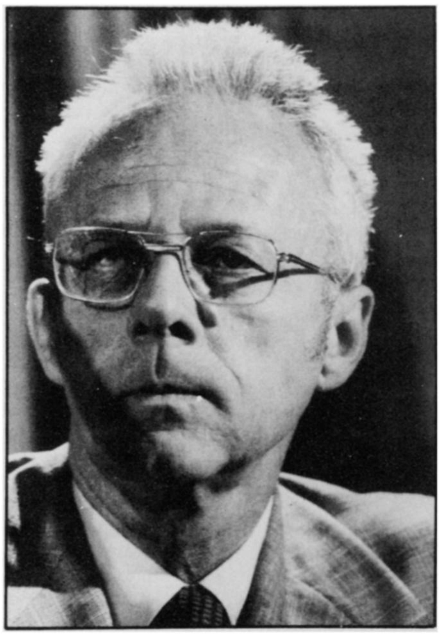
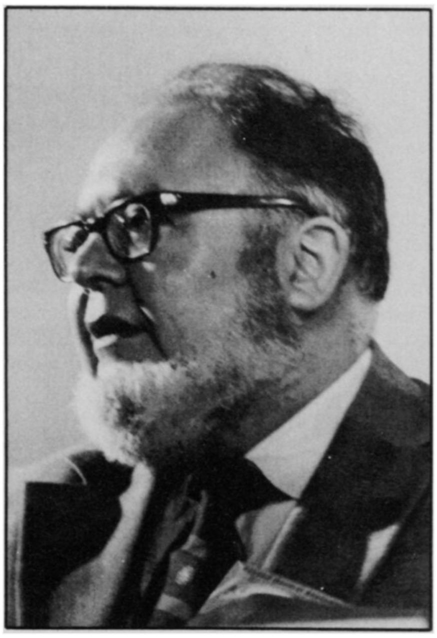
Mankind at the Inflection Point



Forrester: Tensions to mount.



Kahn: "The most important moment."

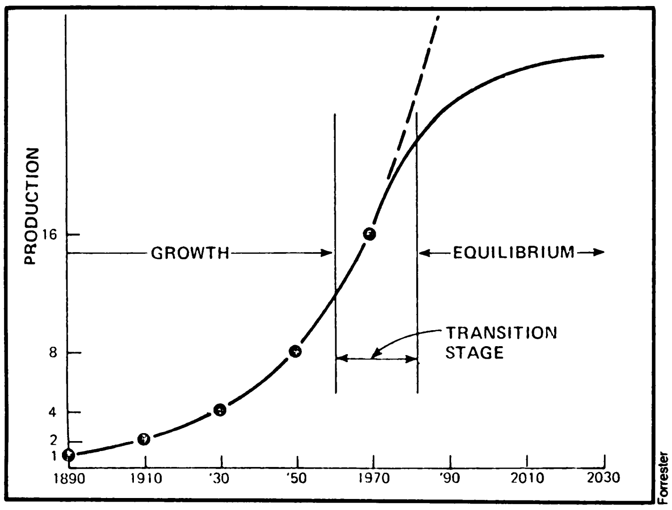
Kennedy: Three new institutions.

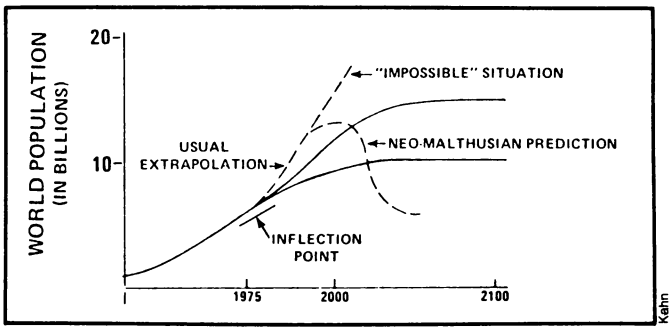
The endless spiral of exponential growth—doubling and redoubling in each successive interval of time—cannot go on forever; simpleminded extrapolations of continuing population and economic "explosions" have long been recognized by most experts as warnings more than forecasts. Now, according to data presented at the second general assembly of the World Future Society last week in Washington, the growth of world population and the cycle of economic expansion begun by the industrial revolution may finally be tapering off.

Pioneer futurist Herman Kahn of New York's Hudson Institute says the latest United Nations population figures show that the critical "inflection point"—where rapid growth slowly begins to level off—may occur within the next three years. The equilibrium "no growth" state, in which the number of births each year equals the number of deaths, would still be years off, but the beginning of a gently decreasing growth rate would be the best indication so far that the world will not overstuff itself with people. The transition to lower growth, Kahn says, could be "the most important moment in history."

Kahn illustrated the meaninglessness of some futurist projections by saying they were like extrapolating the growth rate of a 17-year-old—"he would be a monster at 25." Typically, growth curves having to do with real systems rather than theoretical models tend to rise rapidly to a critical inflection point and then taper off like an elongated "S."

Until now, the question most often raised was not whether population growth could go on forever—obviously it couldn't—but how the critical transition might take place: through gentle tapering off of the growth rate or through a sudden collapse brought on by war and famine, as foretold by 19th-century English economist Thomas Malthus. If Kahn is correct, population is beginning to level off be-





The United States may be entering a period of transition from economic growth to stable equilibrium (left). At the same time, growth of world population appears to be tapering off (above). That the critical "inflection points" of both S-shaped curves coincide is probably caused by increased population pressure on resources.

cause of factors Malthus could hardly have foreseen—a world economy in which children are less needed for security in their parents' old age, in which the expense of raising children rises rapidly as the supply of domestic help diminishes, and in which literacy, urbanization and birth-control technology are radically changing prevalent lifestyles.

What the eventual population of earth will be depends on other future events, however, and Kahn's estimates for numbers of people alive at the end of the 21st century vary from less than 10 billion to nearly 28 billion. Much will depend on continued economic growth in developing countries and slackening growth in the already industrialized ones. Many people in well-to-do nations are already "losing their taste for economic growth," as Kahn puts it, and as affluence becomes more customary, more people will begin seeking other amenities of life, such as leisure and travel.

This theme of diminishing economic growth was elaborated by another veteran futurist, Jay W. Forrester of MIT, though he took a somewhat different view from Kahn. To Forrester, the critical element in what he calls the present "transition stage" of development is that population has already grown so large that it taxes the environmental resources of earth and that new land, new resources, new energy will become increasingly expensive.

The problem, in his view, is that as long as population pressures on natural resources continue, the transition stage is likely to be a time of "greatest social and economic stress," as frustrations further tax the already overwhelmed institutions of government and commerce. Since these institutions seem incapable of defining and enforcing international rules to restrain the pressures on resources, Forrester suggests equalizing pressure at the local level, with each region trying to reach its own compromise between population and the environment.

This theme of decentralization and local responsibility struck an emotionally responsive chord with many participants at the assembly, but others emphasized the need for greater national and international planning and coordination of efforts to meet the challenges of the future. Armed with the rhetoric of the "now generation" and obviously campaigning for *something*, Sen. Edward M. Kennedy (D-Mass.) tried to appeal to both sides in a speech announcing several proposals for new future-directed institutions.

"Congress needs major institutional innovation to equip it for our technological age," Kennedy said. The establishment of the Office of Technology Assessment, of which he is the first chairman, is only the first step, he said. Next must come new agencies to select and demonstrate promising new technologies and some sort of institutional arrangement to involve citizens in policy-level decisions.

To provide independent, objective policy analysis aimed at the future, Kennedy is drafting legislation to establish a National Institute of Policy Analysis and Research (NIPAR), a sort of semi-autonomous think tank. Another bill would establish an Experimental Futures Agency, an independent federal agency to serve as a "national showcase for promising new technologies." Finally, citizens would be encouraged to form local, voluntary Citizens Assessment Associations, funded by Government-backed bonds, to address major policy issues.

The public would need little encouragement to participate in such future-oriented assessment associations, if the development of the World Future Society is any indication. Over 2,000 people attended last week's meeting and the society has grown from an initial membership of 200 in 1967 to more than 16,000 today. But the second general assembly also showed some of the weaknesses of the growing movement, as factions split off and took increasingly hardened positions on various issues. As Herman Kahn observed at a press conference, "This subject is very hard to make professional—probably impossible." □

Why brain nerves can't repair themselves

Unlike many parts of the body, including peripheral nerves, nerves in the brain and spinal cord are unable to repair themselves if damaged. A team of Swedish neurologists suggests one explanation of this phenomenon in the May 22 NATURE. Niels-Aage Svengaard heads the team at the University of Lund.

The tiny blood vessels that usually protect central nervous system neurons from harmful substances in the bloodstream—the so-called blood-brain barrier—do not replenish themselves among damaged central nerves, the group found. So even if central nerves manage to resprout new axons, these axons will probably not survive because they will be attacked by immune fighters or other harmful substances in the bloodstream.

The team also suggests that a defect in the blood-brain barrier might be a major factor in multiple sclerosis and other neurological disorders that comprise long-term degeneration of nerves.

The tiny blood vessels in the central nervous system are unique with respect to their barrier mechanisms, preventing, to a varying degree, many types of substances from passing into the brain and spinal cord from the blood. So Svendgaard and his co-workers postulated that damage to, or defects in, the barrier might underlie nerves' inability to repair themselves if damaged.

In testing this hypothesis they found that if peripheral nervous tissue were transplanted into the brains of experimental animals, nerves in the brain would form functional connections with the implanted tissue. At first the nerve connections functioned well, but then they showed signs of damage, resulting in a progressive deterioration of the entire nerve network. In contrast, such degeneration was not noted in the brain neurons outside of the implanted tissue area.

So Svendgaard and his team determined whether the inability of the central nerves to survive in the implanted tissue was due to a failure of the blood-brain barrier to develop in the implanted tissue. They transplanted nerves from the iris of the eye into the brains of rats. Some of the rats were injected with nerve transmitter chemicals known as catecholamines, which act as an index of whether or not the barrier is present, because they cannot get through the blood-brain barrier.

The iris transplants in the brain, the investigators found, were rapidly supplied with nerves from the brain. In fact, within three weeks the nerve density of the irises was close to normal. But the investigators found that no tiny blood vessels invaded the iris transplants. And the catecholamines, in those animals which were injected with the substance, managed to get into the iris transplants and totally destroy the brain nerves that had reinnervated them. So it looked as if brain nerves could innervate the implanted tissue, but a blood-brain barrier failed to develop in the implanted tissue to protect against harmful chemicals.

Then the investigators did a reverse experiment. They transplanted central nervous system tissue to peripheral nervous tissue in the eye. Here again, implanted nervous tissue was innervated by nerves from the host tissue. But in this situation, a blood-brain barrier did develop in the implanted tissue.

The two experiments show that whether or not the blood-brain barrier develops in regenerating nerves depends on the kind of host tissue that is present. In other words, central nervous system nerves in the brain were unable to provide a blood-brain barrier for the implanted iris (peripheral nervous) tissue. Peripheral nerves in the eye did provide a barrier for the implanted central nervous system tissue.

Central nerves cannot naturally regenerate themselves, the investigators conclude, because they cannot make a new blood-brain barrier for their regenerated parts. And if a blood-brain barrier is not present, antibodies, lymphocytes or other substances in the blood could well invade the new nervous tissue and destroy it.

This latter contention, in fact, is supported by other investigators' evidence that if lymphocytes get into the brain and spinal cord of experimental animals, they produce multiple sclerosis-like damage (SN: 6/15/74, p. 383). □