

The purpose of prophecy is to promote planning; it usually invites ridicule. The most realistic answer to "1984?" should be "who has the foggiest idea?". But most of us do have some ideas, however foggy, and we surely need to plan to accomplish the good and understand the evil in the outlook.

I am deeply perturbed about the survival of human values in the impending evolutionary crisis which biological science has already triggered. The world political conflict is grim enough of itself; even worse, it preempts the energies needed to deal with fundamental problems of human existence and purpose. Contemporary science for the most part is microscopically, if ever at all, concerned with the impact of its achievements on human problems, partly out of discouragement at the possibility of useful impact. Even the pragmatically minded biologist who engineers biological fundamentals to form a legendary "cure for cancer" will eschew responsibility for the social consequences of such a step towards human immortality. The biologist who accomplishes somatic parthenogenesis\* in mice, or the artificial hybridization of cats and dogs -- more remotely, the biochemist whose scientific understanding of the evolution of mammalian DNA makes these technologies possible -- will not be accountable for the perplexities from their human implementation.

Will these be the grotesque accomplishments of 1984? Intellectually they will not be the most exciting; nor do the ICBMs call upon the deepest aspects of contemporary science. But these powers, or similar ones -- the acceleration of mental development of the young before and after birth, the control of sex of offspring, the free transplantation of vital organs (from

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\*"vegetative reproduction", or the budding of a whole organism from a single tissue nucleus, which has been achieved some time ago in frogs!

what sources?), the control of aging, the chemical conditioning of emotional development, the fusion of men and machines, are candidates for the greatest social impact. Not all of these prospects will be fulfilled; others unnamed are no less a perturbation of human identity which only until now has eluded scientific understanding and technical control. Most commentators judge the immediacy of these prospects too conservatively, by the time scale and inadequacy of past biological research. The breakthrough in molecular biology (the structure of DNA; the mechanism of its synthesis, and of the transfer of its information in protein synthesis) should be understood with grim realism, and more particularly by our statesmen as well as our scientists.

A pleasanter topic is the prospect of scientific theory, though this is instantly perplexing. A decade ago, we knew the big problems: genes, viruses, proteins, the chemical basis of life. In the large, these molecular problems have now been answered. An immense amount of filling-in needs doing, and there are bound to be many reversals and surprises. In skeletal perspective, the theoretical basis of contemporary molecular biology was already laid by the iconoclastic patriarchs: evolution (Darwin); particulate heredity (Mendel and Morgan); biomolecular architecture) Pasteur, Ehrlich, Landsteiner) -- concurrently with the flowering of chemistry and physics. What next in such a perspective? I can formulate only one fundamental possibility: the generalization of terrestrial life, either by artificial synthesis, or by the discovery of life beyond the earth (either through the exploration of Mars and Jupiter or intelligent communication over larger distances).

The span from molecule to intelligent organism took two eons, and warrants some attention to the study of organization. The results of mathematical biology so far have aroused limited interest outside practical

statistics and evolutionary theory. Now, communication theory, linguistics, and computer programming have attracted deeper attention to the mathematical description of complex structures, indispensable if cellular organization, embryonic development, intelligence, social structure are to pass deep theoretical understanding. Until then, the main distinction between physics and biology may continue to be the relative weight of universal axiom and happenstance detail. Thus whether 1984 will see significant advances in biological theory is far less predictable than the revolutionary impact of a biological technology issuing from the near-present body of scientific accomplishment.