Science, Technology and Salvation

Science, and the technology which has sprung up as a result of scientific inquiry, has been called the 20th century religion. We love science, and this love affair has been mutually beneficial to scientists and to the public. We give them money for research and they produce benefits for "mankind." Sometimes the benefits have unpleasant side effects, and so we seek to regulate the march of science in order that the negative side effects can be studied and eliminated, but generally the affair is exciting and stimulating. Technologically, civilization is soaring day by day to more spectacular heights. What in the past was merely science fiction is today nearly mundane. Our dazzling display of technological prowess has released us from the confines of the merely possible, and thrust us into that rarefied atmosphere where dreams merge into reality. Our accomplishments are so pervasive that it is difficult to imagine any aspect of our lives that has not been affected by this progress. As a result of our scientific successes, many of us have been mesmerized into believing that no matter how serious our predicament may become, science will "save" us.

The history of technology has uniformly demonstrated the innovative capabilities of the human intellect. From the invention of the wheel to the development of the atomic bomb this expression of ingenuity has been faithfully consistent. The contrast between what might be called beneficial as opposed to destructive technologies may offend your sensibilities, but keep in mind that both are the product of the unquenchable inventiveness of the human spirit. This spirit of curiosity prompted Alfred Nobel to invent dynamite. That dynamite was later used to kill human beings can no more condemn the technology itself than the fact that earlier research in pathogenesis and vaccine development later resulted in the emergence of germ warfare. The tiny silicon chip is used both to guide deadly nuclear missiles and to detect heart arrhythmias. Bioethicists debate the pros and cons of scientific endeavor. The rest of us merely worship at the high tech center of our choice. When we have our doubts about the future, there are always high hopes that our heroic scientists will step in to save the day. But is this idea based in fact, or fantasy?

Technological innovation in modern society is brought to material fruition primarily through the vehicle of manufacture. Manufacture involves the production of durable goods such as automobiles, cameras, television sets, computers, toys, beer bottles, nerve gas--an endless list. The superstructure which renders mass production possible is the huge industrial complex of factories, smelters, mining and logging operations, refineries and assembly plants. The distribution of manufactured goods requires an equally extensive and complex array of shipping, receiving and distribution facilities, interconnected and coordinated by a vast and complex communications network. And, of course, the motive force behind all of this activity is product demand.

The substantive and absolute requirement for the mere existence of manufacture is the availability of raw materials: natural living resources such as timber, rubber trees, poppy plants, sugar cane, whales, fungi, poisonous snakes, fur-bearing mammals, micro-organisms; and natural non-living resources such as silica, coal, copper, uranium, water, salt, oil, and iron. In fact, it is difficult to conceive of any substance or living organism which is not directly or indirectly associated in some manner with manufacture. Additionally, mass-manufacture has its own essential requirement: abundance of resources. Our dependency upon the provisions of our environment is both all-encompassing and absolute. The functional requirements for mass-production include the elaboration of systems and processes which make large-scale manufacture possible. Historically, the introduction of the division of labor, the incorporation of the assembly line and interchangeability of

parts and the use of automation have been the definitive components in the evolution of mass production. Lastly, mass production is both the outcome of mass population and its stimulus.

There can be little doubt that industrialism has, by and large, been a tremendous boon to at least a portion of Earth's human inhabitants. In most nations, where a relatively functional and stable industrial base has been established, the benefits are rather obvious. At least in the short term, ignoring cyclical perturbations, industrialized countries enjoy an enhanced standard of living. Diverse product availability and affordability are by-products of mass manufacture, while the very machinery of production provides employment opportunities for large numbers of people either directly or remotely involved in that production. It is axiomatic that the direct or indirect producers are simultaneously the direct or indirect consumers. The picture is not quite the same, however, for the people of nations which, through historical fate, lag behind the cutting edge of progress. Unfortunately, the bulk of humanity falls into this category. In undeveloped countries, excluding the small ruling elite, living is mainly subsistence. There are no penthouses, spas, crystal or even small savings accounts. In times of famine or political turmoil, even subsistence is unlikely.

Since improvements in living standards (in the sense implied by the availability of goods and services) are closely tied to industrialization, it follows that such improvement cannot occur in the absence of industrialization. Industrialization is proffered by many economists as the solution to the wretched living conditions common to many undeveloped countries. There is, however, a rub. Elevating that portion of humanity which is presently eking out a bare existence (the majority of the world's population) to material parity with the developed countries would require a trebling of the world's present industrial capacity, provided this was even possible. This, in turn, would drastically increase the demands placed upon both our renewable and non-renewable resources. In the short term this is theoretically possible, although as a matter of practicality, highly unlikely. In the long term it would be suicidal. Of course, no mention has been made of the environmental degradation which would ensue were this condition actually achieved, but one might imagine consequences approximating a nuclear winter.

Nor would our concern end if we were able to effectively triple production within the next century or so. At the present global population growth rate of about 2 percent annually, this increased production would be entirely siphoned off by new additions to the population pool. With the population doubling every 40 years (the approximate present rate), it follows that we must double production within that same period, simply to maintain the present inadequate living standard for the human population as a whole. A six-fold increase in world production would be required during the next 40 years to improve worldwide living conditions to the level presently enjoyed by the major industrial nations. Even if this monumental task were accomplished, which it most assuredly will not be, it would not be sustainable for any duration compatible with the notion of survival of species.

Energy technology is the major precursor to any technology. Without it, we should have no technology whatsoever. The discovery of fire was of such singular moment, that barring its occurrence, we would have forever remained another species of hairy ape. The harnessing of fire has led to industrial developments which, beyond doubt, have defined our humanity. The international industrial complex, as well as nearly every other component of mechanized society, owes its existence to energy technology. With the advent of mass-manufacture, energy to drive the wheels of industry needed to be abundantly available and inexpensive. These requirements remain essential today. When the energy needs of society exceed the availability of cheap and ready resources, the industrial wheels invariably slow. Hydroelectric power and oil are the two most common energy

options available to mechanized society. They are common precisely because they are abundant and relatively cheap to produce and transform into usable forms. But this circumstance, with respect to hydroelectric power, has been rapidly changing over the last decade or two, particularly in the United States.

The electrical energy needs in the United States have exceeded maximum hydroelectric output for quite some time. Since dam building is limited by the physical availability of rivers, streams and appropriate sites, increases in hydropower generation have virtually ceased. Nuclear power technology was developed to meet electrical demands which exceeded maximum hydropower output. Had this hydropower shortage not occurred, there would have been no need for industrial nuclear power and the serious problems attendant with its hasty development.

The comparison between hydropower production and nuclear power production was discussed earlier, but bears summarizing because it rather vividly exemplifies the entire spectrum of energy problems which we will inherit in the face of burdensome overpopulation. The only favorable similarity between the two modes of energy production is the generation of electricity, which compared to other common fuels is quite clean and efficient. In terms of complexity, nuclear plants are to hydroelectric dams what the space shuttle is to the family station wagon. It goes without saying that, all things being equal, simplicity is vastly superior to complexity. We wouldn't drive the space shuttle to the corner grocery store if we could take the family car. But the space shuttle was not designed for the same purpose as the automobile. Nuclear power plants are designed for the same purpose as hydroelectric dams. Their very complexity diminishes cost effectiveness and reliability, safety concerns notwithstanding. The lethal and cumulative radioactive waste generated by nuclear powerplants is an immediate and potential problem of such magnitude that the proponents of progress unleashed have opted to minimize or ignore it. There is nothing new about this tactic since it is merely the usual response to out of control population pressures forcing immediate accommodation.

Although all radioactive waste, including that of isotopes used in medicine and research, poses serious disposal problems, the sheer bulk and radioactive longevity of the waste from nuclear power plants, and especially waste generated by defense materials production, creates a severe dilemma. Some of the scores of different radioactive by-products of nuclear fuel processing and nuclear fission have half-lives ranging from hundreds to millions of years. Nuclear power generation continues to increase around the world--chasing the twin devils of population expansion and mass production--while nuclear wastes are sequestered from the environment with an existent technology little distinguished from coffee cans.

The deep burial solution now being proposed by the United States government is fraught with potential difficulties, but is probably the only realistic option when we find ourselves being horsewhipped by runaway forces of expansionism. Deep burial of highly toxic and continuously accumulating wastes, which can retain their lethality for tens of thousands of years, is short-term expediency and long-term foolishness. The earth is still very geologically active, and secure disposal methods require more than a slight preponderance of expert opinion. After all, we have been victimized by the opinions of experts before. A complete and effective solution to the nuclear waste disposal problem will not be a function of opinion, but rather a function of thorough scientific research resulting in certain technological capability. However, the likelihood that we will have such an approach to the problems of nuclear waste is mere whimsy under the circumstances. Rather than proceed with a logical and prudent course of action, we must constantly scurry about, stomping out the numerous fires ignited by our no-limits-to-growth policy.

There are those who decry the development of nuclear power, preferring to substitute oil and coal as the fuel to drive the giant turbines of electrical production. This really amounts to swapping one set of problems for another. On a quantitative basis, nuclear fuels theoretically provide over 2 million times the energy per gram of petro-fuels. Vast quantities of these organic fuels will be required over the next few centuries, without factoring in an unlikely elimination of nuclear power production. More importantly, fossil "fuels" have industrial uses beyond mere fuel. They are the sole source of nearly all the organic solvents, most of the lubricants and virtually all plastics. It would be most unwise to employ this limited resource as a fuel, when not absolutely essential, and lose its application for uses which cannot be otherwise derived.

An additional problem with fossil fuel combustion is the serious matter of environmental degradation. The world's oil supply will cease to exist in a matter of decades (projections will alter the date but not the fact)---but coal will provide a costly alternative. Although both oil and coal use results in extensive pollution, coal renders oil the equivalent of an environmental white knight. Oil is a subterranean resource which can be accessed by the simple procedure of punching small unobtrusive holes in the earth's crust. Relatively little energy and material requirements are needed for its reclamation. Coal, on the other hand, is largely a surface resource requiring massive open-pit mining operations and huge expenditures of energy to acquire and process. Additionally, the combustion of coal in the furnaces of mechanized society produces vast quantities of atmospheric pollutants; the same pollutants produced in the eastern United States and exported, via prevailing winds, to eastern Canada where they toxify lakes and devastate deciduous forests. The environmental damage that is engendered is a consequence of both an economy that is expediency-oriented and a saturation of the carrying capacity of regional ecosystems. Both of these conditions are concomitants of population stress, whether or not population stress is their singular cause.

There are alternatives to fossil fuel and nuclear energy. Among those commonly mentioned are geothermal, solar, wind, and fuels derived from non-fossil sources. Geothermal energy, in the form of heat, is produced as a consequence of the high internal temperatures beneath the earth's crust. Utilization of the heat generated in the planets core as an energy source has been poorly explored, but is being applied to a limited extent in certain areas where natural hotsprings exist, like California's Imperial valley and the very geologically-active island nation of Iceland. In fact, the total energy consumed in Iceland is primarily of geothermal origin.

Similarly, solar and wind power are being used as energy sources in areas where sunshine and strong prevailing winds are common. An extensive array of windmills in the San Bernardino mountains, north of Palm Springs, is currently producing commercial electrical energy. Solar collectors can be used either to intensely focus light from the sun on a heat-absorbing medium or to convert chemical energy into electrical energy through a process called photovoltaics. In the former, water can be vaporized to steam, which in turn can be used to drive electricity-generating turbines (the same mechanical principle used in nuclear power plants). In the latter, "solar cells" are used to channel the energy in sunlight into the stored chemical energy of a battery. The former process is exemplified by an experimental solar energy complex called Solar One in the Mojave desert. Nearly 2000 mirrors focus sunlight on an elevated boiler to convert water to steam.

"Synthetic fuels", produced either by industrial or biological processes, offer some promise as an alternative energy source. Alcohol can be produced by the fermentation and distillation of plant matter (the same process employed by the liquor industry). Nearly any kind of vegetation can be used, although grain and corn are probably the most commonly utilized for ethanol production.

Alcohol can be used as a direct substitute for gasoline in internal combustion engines. It burns "hotter" than gasoline and results in considerably less pollution. Methane (swamp gas) is another potential replacement for fossil fuels (gasoline, kerosene, diesel oil). Like alcohol, methane can be produced from the organic matter contained in plants, or even from sewage sludge. And also, like alcohol, it is an efficient and relatively clean-burning fuel.

Perhaps the "syn-fuel" with the greatest promise is hydrogen. Hydrogen is an extremely flammable gas (remember the Hindenburg?) that when burned, produces only water vapor as a combustion product. Ironically, this combustion product is also one of the best and most abundant sources of hydrogen. From the chemical formula of water, H_2O, it can be readily ascertained that water consists only of the elements hydrogen and oxygen. Water can be electrolytically decomposed into pure hydrogen gas and oxygen gas. When hydrogen is burned, it recombines with the oxygen in air and again becomes pure water. No "greenhouse" gases or toxic pollutants are produced.

These alternatives to oil and nuclear energy almost sound too good to be true. With all the hysteria about dependence on Persian Gulf oil, the hazards of nuclear energy and the pollution of the planet as a result of using nuclear energy and fossil fuels, why has the world not shifted to alternative energy sources? The technology certainly exists. These are not "Star Wars" fantasies where the dreams outstrip the science. Yet the U.S. government spends billions of dollars on esoteric research including Star Wars and space exploration, and billions more on foreign oil acquisition, safeguard and pollution abatement. And, in the latter case, all this money is being spent on a resource (oil) which is a major contributor to severe environmental pollution and is about to run out!

So, is the U.S. government stupid? Well.... Yes. But the problem, as usual, is complex. The complexity of the situation is used as an excuse for inaction and to defend the status quo. Perhaps we might glean some insight into the problem if we posed as administration officials and then responded rationally to our own assertions. We begin by claiming ---

<u>We must continue BAU (business as usual) because:</u>

** Assertion: Existing alternative energy production, in totality, is not even capable of providing the amount of energy America wastes every day, let alone needs.

Response: The reason this is so is that energy conservation is not at the top of our list of priorities. It's not even on the list. So it makes it easy to characterize existing alternative energy as insufficient.and economically uncompetitive.

** Assertion: Even if we instituted an effective conservation program, alternative energy could not substitute for fossil fuel, because it could not possibly provide the immense amount of energy America uses every day.

Response: This is true. Of course, no one in government is even trying. Basic research and funding of alternative energy programs is not at the top of our list of priorities. It's not even on the list, because fossil fuels are the entire list.

** Assertion: Any kind of alternative energy production is much more expensive than oil and nuclear power.

Response: Oh, really? It's too bad the true price of oil and nuclear power is not reflected in the pump price of gasoline or in the utility bill. The energy industry in the U.S. is heavily subsidized by the taxpayer. Taxpayers and consumers have already paid for the tremendous development costs of nuclear energy (billions of dollars), and will be paying the hundreds of billions of dollars needed to clean up nuclear waste sites, to decommission old nuclear plants (scores of them) and to build "permanent" underground nuclear waste repositories. The money necessary to buy foreign oil, defend the Persian Gulf and clean up Exxon's oil spills represents a truly obscene amount. In addition, trillions of dollars will likely be required to deal with the consequences of the greenhouse effect, should this fossil-fuel induced disaster actually materialize. And you call this inexpensive?

** Assertion: The economy cannot handle the kind of transformation required to achieve this ideal goal. We simply cannot interfere with "business as usual". (Otherwise we might not get re-elected)

Response: A very self-serving, short-sighted and consummately political position to take. The economy can either evolve in a manner that will ensure the continued survival of the human race, or natural law, which has no regard for anything living, will prevail.

Of course, alternative energy development is not only essential, it is inevitable. But there are, at present, many problems associated with its full development and implementation. A major snafu in the alternative energy picture is not, however, a lack of technical know-how. This is not to say that current technology is complete and need not be improved upon. It had better be improved upon. But the laws of physics simply remind us that "there is no free lunch". It takes energy to make energy. Wind power might be clean and wonderful but we cannot provide endless resources (energy and material) required to build, maintain and replace tens of millions of wind turbines. The manufacturing processes involved in hydrogen generation, solar collector and storage production and other alternative energy technologies will require energy (lots of energy), will consume large quantities of limited material resources and will create pollution and waste disposal problems.

Alternative energy production needs to be rigorously pursued, but it cannot be considered as a replacement for traditional energy sources. It is estimated that a solar energy facility (like Solar One) would require 20 square miles of land to produce energy for a million homes. This is the number of "new housing" permits issued **annually** in the U.S. The residents around the Mojave desert are already beginning to complain about the destruction of this fragile desert ecosystem because of encroachment by a network of mostly alternative energy power generating facilities. The resplendent beauty of this area is gradually being violated by the presence of "windmill orchards", solar mirror arrays, geothermal plants, power corridors and microwave relay stations, not to mention the roads necessary to provide access to these facilities. Alternative energy may be "clean" when compared to fossil fuel, but the impact of its development and utilization is anything but clean. It's essentially another form of "heavy industry" when viewed in the harsh light of the massive energy needs of a highly overpopulated world. The idea of substituting "clean" ethanol for "dirty" gasoline, to any extent commensurate with reducing atmospheric pollution or easing demands on fossil fuels, is a silly one. Ethanol is essentially an agricultural commodity. As arable land is lost through soil erosion, water diversion and depletion, and desertification, at a time when more land is needed to provide food for a growing populace, utilization of this diminishing resource for fuel enhancement is irrational.

By far, the very best of all the energy options currently available or technologically feasible, has been around since the late 1800's. Hydroelectric energy satisfies nearly all the major requirements of an ideal energy. It is clean and virtually non-polluting. It's abundant, inexpensive to produce and causes minimal environmental damage. It's efficient, safe and renewable. Although dams do change ecosystems, they do not destroy them. Damming of streams does cause problems, but not insoluble ones. While providing large quantities of electricity, even the world's most massive structures are aesthetically rather unobtrusive (compared to, for example,. an oil refinery). In fact they are often tourist attractions. In addition, reservoirs formed behind dams most often increase the recreational opportunities of the populace while not despoiling the beauty of an area, and serve the added benefit of flood control. It is extremely unfortunate that the human population has not been tailored to the availability of such a nearly perfect energy source (and other resources), and instead requires utilization of hazardous, expensive and environmentally destructive energy alternatives in an ever-escalating fashion.

The preceding discussion reflects many of the inherent limitations of technology. Science itself is limited by the "laws of nature" as well as by prevailing political, social, religious and economic circumstances. Science can, however, be a wonderful tool, but it is powerless in the face of ignorance and apathy. It will never be able to solve the problem of "too many people" through compensatory interdiction, and it certainly cannot help to solve problems that remain unrecognized.

The question arises in some circles, among laymen and professionals alike, as to the possible future discovery and development of exotic energy sources and technologies, which will relieve mankind from the encumbrances of cause/effect and finitude. So far this condition has not occurred. We have not invented any perpetual-motion machines and our one experience with an exotic energy technology, nuclear power, has been rather disappointing. We continue to rely on mundane, incremental refinements and energy alternatives which, to date, have offered no panaceas. Although ideas may be the wellspring of progress, fantasies are not. Mass production dooms us to an uneasy vision of the future, and mass production is the child of mass population.

If the forces of excessive procreation and mass production generate environmental degradation, which they do, we can at least find a limited solace in pollution-abatement technology. As under-available, unrefined and poorly applied as this technology presently is, it is the predominant reason the top-heavy human-population has managed to stay afloat at all. Although pollution control technology cannot possibly sustain our exploding population forever, it can partially ameliorate the devastating effects of rampant resource exploitation and buy time for us to come to our collective senses. Product and materials recycling reduces the rate of raw materials used. Sewage treatment plants can significantly reduce the pollution of our water resources, and recycling of sewage sludge can benefit the fertilizer industry. Catalytic converters can lower toxic and particulate emissions from automobiles and wood stoves. Smoke stack scrubbers and filters can reduce, and theoretically eliminate, some of the gaseous precursors of acid rain. Complex garbage incineration plants, while increasing air pollutants, do provide some relief from reliance on out-of-sight, out-of-mind waste burial procedures, while generating steam heat as a moderately useful by-product. (However, this fairly recent technology has already begun to stir the beast of rancorous disapproval in many, and is reminiscent of the nuclear power fiasco in that it is being hastily developed and instituted in response to a garbage crisis induced by overpopulation.). In the area of food production technology--biological methods of insect control, fish hatcheries, plant hybridization techniques, aqua-culture, selective animal husbandry, and advances in agriculture methodology--all help to increase food availability.

Food-production and pollution-control technologies have the effect of increasing the carrying capacity of the planet, i.e., a greater human population can be sustained than would be possible if these advancements were unavailable. Nevertheless, an absolute sustainable population limit is imposed by availability of resources and by the viability of the global ecosystem. Overpopulation taxes natural resources and reduces ecosystem vitality. The point at which this occurs depends upon numerous variables, including the number of years a species can exist, given the demands that species places upon its total environment. Major environmental alteration, as a consequence of man's activity, has occurred in a time-frame representing a tiny fraction of human existence to date, and an infinitesimal fraction of our potential existence. The requirements of the existing population of 5 billion humans, living under acceptable circumstances, exceed the sustainable carrying capacity of the planet. A further increase in the population does not bode well for our future well-being.

All technological innovation, which historically has been the hallmark of mankind, has been the result of our desire to improve the conditions of our existence. Often, however, technologies have had negative effects which were unintended. Medical technology and its antithesis, military technology, are exemplary of this circumstance. Innovations in medicine are not necessarily all good any more than military innovations are necessarily all bad. Both interact and interrelate with each other and with other technological disciplines. Their essential justification is the use to which they are put. Advancements in the field of medicine have rid man of many familiar antagonists, ranging from toothaches to bubonic plague. Diseases which once ravaged whole populations have been largely eradicated. Individual suffering has been relieved to an extent once presumed impossible, and a new frontier of organ transplants, genetic engineering and bionics is just emerging. Life expectancies have increased by leaps and bounds, not only in developed countries, but worldwide. And for the first time in the history of medicine, effective birth control devices, substances and procedures are finally being developed.

The collective contributions of medical advancements have not only ameliorated suffering but have contributed immensely to the population explosion. Having eliminated the epidemics which once devastated large segments of the human population, modern medical practitioners are now focusing on the esoteric, exotic and rare disorders that afflict individuals. Tremendous amounts of money and effort are being channeled into organ transplants for old and young alike, embryo transfers for infertile women and life support systems for geriatric and terminally ill patients. It seems as though the medical community and the rest of us have lost perspective on priorities. While the world labors in the yoke of overpopulation and its tragic consequences for the impoverished multitudes, the "magic men" of science labor to grant the gift of immortality to the few who can afford their lavish services.

The responsibilities of the medical profession extend well beyond the narrow creed of "healing the sick." Preventative medicine has a value enormously greater than restorative medicine but its active practitioners are few because of the difficulty of realizing personal monetary gain. The dissemination of nutritional information and the provision of proper nutrition to the populace, for example, are not overriding responsibilities of medical practitioners, per se, but they should be overriding concerns of the medical profession. Malnutrition, starvation and mental health are conditions of far greater significance and import worldwide than congenital infertility, Alzheimer's disease or systemic lupus erythematosis. Billions of people suffer under the former while a comparative few are afflicted with the latter. Malnutrition, starvation and poor mental health are medical conditions equivalent in every particular (except cause) with endemic or contagious diseases of epidemic proportion, yet efforts by the medical community at eradication of these global

afflictions is seriously wanting.

Elimination of these woeful human conditions is not a matter of insufficient technology. Malnutrition and starvation have simple medical determinants and are medically curable, unlike acquired immune deficiency syndrome. Although the former conditions have afflicted billions for centuries while the latter condition has afflicted a few thousands for little more than a decade, AIDS has captured the imagination and concern of the medical profession--as befits such a deadly and contagious disease--yet cases of malnutrition wallow in the sentiment of regret. Why is this? A cursory analysis would point to two distinct reasons. First, the world medical community is relatively unconcerned with medical conditions, however debilitating and pandemic, that can be rationalized as manifestations of the prevailing social order and not directly induced by pathogenic or hereditary elements. Second, monetary redress, despite Hippocratic idealism, is the major driving force behind medical accomplishments. Doctors who apportion their time to dealing with world malnutrition or mental health problems, which logically fall under their ethical and professional purview, do not reap the financial blessings otherwise gained by treating specific maladies. All the medical technology presently available or conceivable will not remedy medical conditions of human suffering when narrow self-interest prevails.

So medical technology, as impressive as it seems, and the practice of medicine in general are subject to mixed reviews. They have contributed to a massive increase in the world population burden while relieving much suffering. They have focused on individual maladies and specific disease processes, while largely ignoring major medical problems which are both more all-encompassing and more intractable. The immediate future direction of medicine is clear. It must become more actively involved in solving major problems in preventative medicine, mental health, malnutrition and starvation, and less involved in exciting but esoteric medical research and practice. Because doctors are held in such high regard, they could do much to change our outlook on overpopulation. Since the medical community has contributed so significantly to population growth, it must now focus on medical technology and techniques to regulate that growth. If doctors can refuse to deliver babies because of the potential risk of lawsuits they can certainly act more ethically and less selfishly by discouraging the populace from producing excessive numbers of babies. And finally, the medical profession must help provide not only the means to achieve these goals, but, more importantly, the stimulus.

Research in the field of reproductive physiology has brought forth effective means of preventing birth. These means provide either temporary barriers to conception or permanent barriers and include various methods, devices, substances and surgical interventions. From the standpoints of both human well-being and human survival, birth control technology may well be the single most important development to emerge in recent history and the one which could have the greatest impact on the future. Sooner or later the population growth rate will have to cease altogether, and shift to a negative growth rate for some period of time, unless we choose to rely on cataclysm to control our numbers. It makes no sense to wait for the harsh reality of necessity to coerce us into a course of action reason has long been dictating.

Advances in food production technology, pollution abatement technology and energy technology, though they are sure to occur, can only delay the inevitable need for population control. Cold fusion, the safe nuclear energy which will create more energy than it uses, remains a pipe dream and still will provide no free lunch. Resources must be used to create and deliver this energy, and energy does not provide land upon which to grow food. Space research may provide an outlet for our creative urges, but it most emphatically will not diffuse the population crisis. If anything,

space exploration has succeeded in dispelling fantasies of life-supporting worlds, other than Earth, within our own solar system. At any rate, transporting billions of people to remote planets or artificial space stations is an irrational notion that need only be entertained by science fiction writers. High resolution space photography of the earth is a tool which will enhance our ability to locate and inventory many of Earth's resources, but it will not enhance their abundance. In fact, space exploration and utilization will only further diminish our present supply of resources. The one technology which man has so ingeniously developed that might preclude the necessity for rational and deliberate birth control is our stunningly sophisticated military apparatus. We might have the opportunity to start all over, though , it is unlikely we would have that choice.

So in our examination of the wonderful world of science, it seems unlikely that science will find a way to save us from ourselves. We will have to accept the reality that fantasies are only possible on television or in the movies. In and of itself, science cannot prevent our extinction, or that of most other species on the planet. Specific scientific research will be a great help to us in assessing the damage and developing restorative technologies, but it is up to all of us, not just the magical practitioners of science to carry the torch that illuminates the future.