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Natural Science and Two Themes in Human History*

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Think about what human history could have been after Adam and Eve rebelled. In their rebellion each of them in effect said, "I can live without God." Suppose that God had called their bluff. Satan would have captured them completely. From that time on there would have been nothing but hatred and fear in the world. I can only speculate what life would have been like. Surely there would have been constant warfare; a permanent fear about what would happen next; continual physical and mental pain; hunger; deceit; disorder of all kinds; and eternal death, permanent separation from God. It is not possible to imagine how bad existence could have been—if, indeed, there

would have been "existence."

What has actually happened? Human history has indeed been filled with hatred, fear, warfare, pain, hunger, deceit, disorder, and death. But there is more. God sent his Son to save people from the clutches of Satan. Remember, however, that Christ's work means more than the substitution of eternal life for eternal death in the scenario just described. Christ's work

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also means that human history is not the unrelieved story of pain and suffering depicted in that scenario. God did not leave the human race to its own devices once it rebelled against him.

What we see, then, is that there have been two themes in history. The sin of Adam and Eve and its consequences are facts of human history. But God also redeems creation: eventually there will be a new heaven and a new earth. It is not that there is a kind of dialectical back-and-forth in history, with first one side and then the other prevailing. Rather, throughout history the two themes have always been present.

Themes are not abstract things. They manifest themselves in real-life events. My point in this essay is that these two themes, one a rebellion against God and one a faithful response to his claims, have always been intimately associated with the achievements of the human race and in modern times are intimately associated with the natural scientific enterprise. Here are some examples.

Human Achievement and Rebellion Against God. To understand what has happened because of the presence of sin and death in the world, consider the first sin, the claim made by Adam and Eve summarized in the statement, "I can live without God." In this context it was wrong to say "I." It was also wrong to listen to the voice of someone other than God—here, Satan—concerning the nature of life and the rest of the world. Finally, it was wrong to seek in creation—in this case, the fruit of the tree—the source of power, rather than to look to God, the creator of power.

The sin of Adam and Eve was original sin in two ways. First, it polluted the human race and paved the way for future sin. Second, it set the pattern for future sin, since human beings continued to sin in the same three ways: relying on self—individualism; listening to strange voices, ultimately inspired by Satan; and putting their faith in various parts of creation rather than in the Creator.

These sins have polluted human achievements. Thus, a king battling his way to the top may trust in self. He may feel that he rose to the

top because of his own ability and power. If he refuses to listen to the Lord, and says he will go his own way, he is actually listening to Satan. When he puts his ultimate trust in chariots and not in the Lord, he puts his trust in creation instead of the Creator. After he wins his battles, his *achievement* wins him a place in human history. Is it not possible to describe all sinful achievements in the same way? Is not this the way all sinners—not just kings—live? To sum up, rebellion against God in human history is linked intimately with the way human beings strive and achieve.

Human Achievement and Obedience to God. In the first chapter of Genesis God instructed human beings to have dominion in the earth—that is, rule in the earth—and to replenish it. The statement that human beings were to rule and replenish was a statement about creation: in the earth sinless image bearers of God could and would obey the command to rule and replenish. There were to be human achievements. Before the first sin, human beings and the rest of creation were perfectly matched. Human activities aimed toward ruling and replenishing naturally flowed from obeying God.

Would sinless people immediately be able to travel to the moon? Would the first people compose symphonies? No; even in the sinless state there would be development. The first human beings possessed *potential* in the best sense of the word. They had an immense potential to accomplish tasks, such as traveling to the moon and composing symphonies. But they would first need to learn to accomplish simple tasks. They would then build on these achievements. No one can say how rapidly sinless people could have improved in their ability to carry out the mandate to rule and replenish. But there can be no doubt that their abilities would increase by steps.

The entrance of sin did not entirely wipe out the possibility of obeying God by ruling and replenishing. Yet the effect of sin was drastic: no effort of human beings to rule and replenish would be free of sin. Not only the efforts, but also the motives for ruling and replenishing would always be impure. Now ruling and

replenishing properly could take place only if sin were removed. Thus human activities designed to bring about ruling and replenishing in a sinful world must be seen as pointing to Christ's redemption of creation, a redemption which will produce a new heaven and a new earth.

Even in this sinful world, human beings have achieved over the years. Looking back, we realize that greater achievements became possible as each generation learned and passed on all kinds of wisdom, knowledge, and skills to its successor. But throughout it all, two themes, sin and redemption, remain.

Tools and Human Achievement. What do human beings achieve in the physical aspect of creation, that is, the aspect having to do with

others are weapons. With every new tool, the human potential to achieve increases. New knowledge can also function like a new tool. Thus, a person capable of using both arithmetic and algebra can accomplish more than one who can use only arithmetic. Bodies of knowledge such as arithmetic and algebra are tools, extensions of the human person.

Whether the tool is a physical thing or a body of knowledge, human beings can achieve more in one century than in the previous century because more tools are available. If we could look in on the life of early human beings, we would no doubt see things completely foreign to our eyes. But the difference would not be due to human potential for achievement: they possessed the same potential as we possess.

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material things? One must realize that in either a sinful or a sinless world people achieve by steps, according to the tools available at various times in history. The first people after Adam and Eve had potential, but few tools. Yet they could do things with their hands. Soon, according to Genesis 4, metal workers could fashion musical instruments and tools of bronze and iron. A person with a tool in hand could accomplish more than with an unaided hand. As a result, more human beings realized their potential, for the tool became the extension of the person. Ever since, there have been additional extensions. Some of these extensions are increasingly complicated tools operated by human hands; others are chariots, cars, tractors, trains, planes, and other vehicles; still

Much of the difference would lie in the tools developed.

Up to this point I have stressed physical achievements, such as vehicles, hand-held tools, or bodies of knowledge such as branches of mathematics. But human beings achieved more in other areas of life as well. They composed and produced music, painted, sculptured, and wrote literature. In all these areas the present generation achieved more than previous generations. Each generation stands on the shoulders of its predecessors. Remember, however, that all the activities discussed here are uniquely human activities. As the human race learns more of what human beings can achieve, it understands better the greatness of the human potential. Put in

another way, we understand better as time passes what it means to be human.

Christians tend to think of human achievements in terms of the sin which permeates those achievements. In this discussion, however, I shall separate achievements from the sins associated with them by first describing some important natural scientific achievements. After this description, I shall show how those achievements are intimately associated with modern human sin.

Some Modern Scientific Achievements. During the 20th century, scientists have successfully explored the atom, of which all matter is comprised. As a result, the nucleus of the atom is now approximately understood. "Nuclear chemistry" is responsible for nuclear bombs and also has peaceful applications.

Among the peaceful applications, nuclear power plants can produce electric power because we understand how to extract energy from the nucleus of the atom. In many countries nuclear power is a principal source of electric power. Understanding the nucleus of the atom also makes possible those branches of science which utilize radioactivity. For example, medical research, diagnosis, and treatment are scientific activities which frequently depend upon the use of radioactive materials. Thus, *medical research* on the metabolic pathways of certain anti-cancer drugs often utilizes molecules tagged with radioactive atoms; in *diagnosis*, physicians can locate some brain tumors using radioactive substances, making dangerous exploratory surgery unnecessary; and in *treatment* physicians use radioactive iodine to destroy malignant cells in a cancerous thyroid gland.

The understanding of the nucleus of the atom would not have been possible were it not for the development of appropriate mathematical tools, such as Einstein's extremely sophisticated special theory of relativity. The famous equation, $E = mc^2$, absolutely necessary for the development of nuclear chemistry, is a product of that theory.

The other part of the atom which has been explored is the region outside the nucleus, that is, the region occupied by the electrons of the

atom. The behavior of atomic electrons is now understood well. Understanding the behavior of these electrons constitutes the basis of the science of chemistry. Just as with the nucleus, developing an understanding of electron behavior required advanced mathematics. (Most of the experimental and mathematical triumphs associated with the investigations of the nucleus and the electrons outside the nucleus occurred during the first thirty years of the twentieth century. As a result, those three decades are often referred to as the most important thirty years in the history of natural science.)

Because the basis of chemistry is now understood, several kinds of chemical development became possible. Much of the world's energy is chemical energy; to use it and manipulate it in modern ways, we must comprehend how the electrons outside the nucleus of the atom behave. This statement holds for the many different kinds of energy, such as energy obtained by burning coal or oil or biochemical energy used in muscle activity. A related development is the understanding of how atoms bond together to form molecules and other substances. The development of this picture depended upon prior understanding of electron behavior. With an understanding of bonding, it becomes possible to work out the details of how both small and large molecules are put together. Great advances in biochemistry and understanding of life processes have been some of the consequences of these developments. In addition, it eventually became possible to synthesize many other desired substances, such as fabrics, new papers, new dyes, and many construction materials for machines and buildings. The tremendous materials revolution became a reality.

Not only chemical products, but also chemical processes depend upon basic chemical understanding. Thus, for centuries chemists (earlier, alchemists) attempted to develop chemical purification processes. Modern chemical knowledge, based on understanding electron behavior, was necessary before the best methods of purification could be developed. These processes and this

understanding were necessary prerequisites for the understanding and subsequent manufacture of semiconductors, which in turn led to the invention of transistors and computer chips. Understanding other chemical processes, the chemical reactions of photography, made possible the mammoth photography industry.

Some important modern scientific developments are not closely related to understanding the structure of the atom. An example is the modern explanation of electromagnetic radiation. This radiation includes visible light, ultraviolet light, X-rays, infrared radiation, microwave radiation, radio waves, and a few other kinds of radiation. It is difficult to imagine what our lives would be like without—for example—radio, television, and X-ray machines. More recently, scientists developed LASER ("coherent") radiation, which has many uses in space technology and medicine. (LASER is the acronym for Light Amplification by Stimulated Emission of Radiation.)

Modern fundamental discoveries in biology, particularly in molecular biology, have had and evidently will have far-reaching results. Scientists today manipulate genes, bacteria, and bacterial growth. What can happen when human beings splice genes is no longer speculated on only by those who write science fiction.

Before turning to the effects of sin on developments in the natural sciences, I want to examine two matters associated with modern natural science which are also of interest to us in considering the two basic themes in human history.

First, modern developments have given human beings more control over their physical environment than they once had. Fundamental understanding in the health sciences has improved public health and lengthened life. Epidemics are virtually unknown in many parts of the world. One no longer expects most babies to die within a few years. At the same time, modern developments in the natural sciences have greatly improved the food supply. The amount a person must work to stay alive is much less than it once was, so workdays

have been shortened. In many places, luxuries abound. All these developments help human beings control the environment more fully, usually improving the quality of life. In my opinion, it is wrong to become so obsessed with the effect of sin that we cannot perceive that people have indeed responded to the command to rule and replenish, even though this response has been distorted.

Second, the modern computer provides a magnificent lesson in what can be achieved by work in the natural sciences. The modern computer is possible only because of coordination of developments in several areas of the natural sciences, especially physics, electrical engineering, chemistry, and applied mathematics. Consider how the computer has extended what human beings can accomplish: a modern supercomputer can store 32 million 18-digit numbers and process them all in two-tenths of a second; or, it can carry out any equally complicated process with the same rapidity. As a result of this new human capability, large areas of modern life have been affected. Examples are manufacturing; mass communication; mass transportation, such as air travel; record keeping in schools, financial institutions, other businesses, and government offices; greatly enlarged mailing lists; most kinds of writing, including publishing; processing of weather data for weather prediction; radio control of satellites; medical diagnosis; analysis of voluminous information, such as scientific information; and a revolution in the natural scientific enterprise itself, the very enterprise which produced the computer.

The existence of the modern computer shows how much human capability can increase in a few years as a result of natural scientific activity. It is as if human capability has suddenly taken a giant leap forward. Compare what a person could do thirty years ago with what that person can do now if he or she operates a computer which processes 32 million 18-digit numbers in two-tenths of a second. Are there more leaps in capability still to be realized? What is the limit?

There are two ways to think of a limit. First, there are theoretical limits. The computer

utilizes the speed of electromagnetic radiation, the speed of light. Nothing travels faster than the speed of light. While we may anticipate computers even more rapid and sophisticated than those we now have, we should not base our expectation on the discovery of a means of transmitting a signal more rapidly than the speed of light. This is an example of a limit which has been discovered in modern times.

The other way of considering a limit is to think of what will eventually happen to the human race. There will be a time when Christ returns. There will be a new heaven and a new earth. I suggested earlier that what happens during human history cannot be separated from life on a new earth. The constantly increasing human capability will not be thrown onto a junk heap when we begin to live with Christ. Beyond that, we can say nothing. We do not know what "development" means in the context of the new earth; and least of all do we know what limitation means. We do know, however, that what we can accomplish by the time Christ returns is limited. Even so, present activities cannot be completely separated from our activities when death and sin are no longer realities.

I have discussed some of the positive human achievements in the natural sciences. Human beings have shown that the human potential is far greater than was once imagined; and there is a hint of much greater things to come. But every development has been polluted with sin. Let us now see what has happened.

Dependence of Modern Evils on Natural Science. All the modern natural scientific triumphs listed in the previous section are used in a sinful way and have contributed to misery in modern life. I shall consider three areas of modern life which have been affected.

(1) Consider warfare. Even without nuclear bombs, conventional warfare is now unbelievably awful. But this would not be the state of affairs without the modern chemical knowledge which makes possible the construction of large bombs and much worse poison gas warfare than previously existed. Every conventional bomb depends upon chemical reactions; and there could be no such dependence if

chemists did not understand how to manipulate the electrons outside the atomic nucleus. Every poison gas bomb depends upon similar expertise, expertise used to synthesize and purify new compounds. For example, in a new kind of poison gas bomb the gas is produced by a chemical reaction between two compounds in the bomb. These compounds are kept in separate compartments until the poison gas is to be produced and released. As a result, these poison gas bombs can be stored for a long time and present more of a threat than the older type of poison gas bomb.

The size of a nuclear bomb is vastly larger than the first ones used, those dropped on Japan near the end of World War II in 1945. Nuclear bombs release a vast amount of both nuclear energy and deadly radiation. Perhaps the life of an entire continent could be wiped out by a few bombs. None of this would be possible had not human beings gained insights into the nature of the nucleus of the atom. Furthermore, the danger of nuclear bomb warfare would not be nearly as great if nations were not able to send missiles from any place to any place on earth; and this capability would not exist were it not for many modern developments in physics, chemistry, and engineering. One of those developments is the modern computer.

Another way to look at modern warfare is to consider how many persons died in recent wars. With each succeeding world war, a larger fraction of the world's inhabitants became involved and a larger fraction of the participants died. In World War I (1914-1918), about 20 million died; in World War II (1939-1945), about 40 million died. Except for the most primitive nuclear bombs used at the end of World War II, these wars were fought with weapons which are now obsolete. Every argument points in the same direction: we can expect a great increase in the number killed in a future world war. Surely there can be no doubt that in the next world war many tens of millions—one hundred million? five hundred million?—would die, and that the after-effects, especially those due to radiation, would last for decades or centuries.

(2) What human beings are doing to the environment is extremely serious. Even without war, irreparable damage is being done to our air, water, and soil because of certain technological practices, practices which rest on modern scientific discoveries. Human activities which damage the environment of the earth fall into two categories. Each kind of activity is a distortion of how God could be honored if we used the results of modern scientific discoveries. For reasons given below, I shall also discuss a third kind of environmental problem.

First, some agricultural practices harm the topsoil and water needed to sustain agriculture. The improper use of chemical fertilizers, herbicides, and pesticides has either damaged or removed the topsoil in some parts of the world. These fertilizers, herbicides, and pesticides would not exist were it not for the basic understanding of chemical reactions and chemical bonds gained during the last one hundred years.

Indiscriminate use of pesticides can cause the appearance of immune strains of pests. Then the latter end is worse than the first. Also, some of these substances, not degrading as they should, pollute streams and lakes. These undegraded materials in streams and lakes begin a chain reaction: The undegraded substances kill some aquatic life; decay of dead organisms consumes oxygen dissolved in the water; fish and other aquatic life which require oxygen die; some people who depend upon this aquatic life for food suffer; there are then adverse economic consequences. Ironically, societies sometimes attempt to alleviate economic problems by encouraging farmers to increase food output by using more chemical fertilizers, herbicides, and pesticides.

Second, certain industrial practices (which would not exist were it not for modern scientific discoveries) have harmed our physical environment extensively. Consider, for example, the roasting of ores and the burning of fossil fuels. The more ore roasting and coal burning, the greater the amount of sulfur oxides introduced into the atmosphere. At the same time, the amount of nitrogen oxides introduced into the

atmosphere by human activity—for example, by burning another fossil fuel, gasoline, in high-temperature automotive engines—has increased. The oxides of both sulfur and nitrogen are acidic, and therefore when they are introduced into the environment, whether it be by smokestack or automobile exhaust, acid rain is a result. For many decades scientists and engineers have known about the deleterious effect of acidic materials spewed into the environment. What is wrong—sinful—is assuming that we can increase the amount of such materials with impunity.

Perhaps such careless thinking is a kind of industrial sloppiness which is associated with other industrial practices. For example, for a long time waste mercury arising from industrial operations has been introduced into public waterways, no doubt with the convenient assumption, a sloppy assumption, that this material would be diluted enough to render it harmless. The assumption concerning dilution was exactly wrong. Mercury actually becomes more concentrated as it passes through the food chain, ending up much more concentrated than the uncritical polluter might assume. Any mercury, especially mercury in food, is a very dangerous poison.

Pollution due to industrial operations is often the consequence of careless thinking—perhaps, self-serving thinking. Pollution arising from the indiscriminate use of lead illustrates the point.

Tetraethyl lead, a compound produced by modern chemical technology, is often added to gasoline used in internal combustion engines. Its purpose is to delay explosion until the piston is in the correct position. In this way, engine "knocking" is prevented; adding tetraethyl lead to gasoline increases its "octane number." Engines operating under these conditions can achieve a higher compression ratio, enabling automobiles to start up better and increase their speed more easily.

Pollution occurs because the lead must be removed from the engine, for, as lead compounds accumulate in the combustion chamber, the engine requires fuel with a higher octane rating. The problem is solved by adding a substance to the fuel which causes lead to be

ejected from the exhaust into the air near the automobile. Millions of vehicles throughout the world use leaded fuel; consequently, very large quantities of lead enter the atmosphere. Persons near roads, often children in cities, inhale this lead. Some lead falls on fields near roads and enters the food chain. Lead is a serious poison—known to be a poison even by ancient Romans—which can cause many serious illnesses, including anemia, nervousness, headache, convulsions, mental disturbance, and infertility. It is often fatal. According to

very great damage will be done to the environment, more than the human race has ever known.

Sin may be involved in these activities. It is difficult to point to specific wrongdoers responsible for producing these gases, but people generally are careless and hence they tend to neglect to count the cost before embarking on a new technological activity. Such neglect may stem from the sin of greed or sloth. But what is certain—and this is far more important—is that God permits evil in the world. Once Adam and

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one observer, the lead used to obtain higher compression ratios in modern automobiles may well be one of the principle causes of modern urban unrest.

Third, certain human technological activities may *possibly* be responsible for immense future damage to the environment. I could have put these activities into one of the first two categories; but I take up the matter separately for three reasons: First, the matter is not certain. Second, if the worst fears are justified, untold damage will be done to all living things. Third, if damage is done, it may not be possible to link the results to specific sinful acts. Before discussing the matter of sin further, I shall describe the problem.

The concentrations of four gases in the earth atmosphere are increasing at least over a short period of time. These four gases are carbon dioxide, nitrous oxide, methane, and a group of gases called chlorofluorocarbons. Each increase can be linked at least partially to human activity. The observed increases may be only temporary. It is likely, however, that the increases are not temporary and that in the long term

Eve sinned, they and their descendants could expect that God would no longer shield them from what could happen to them. Adam and Eve and their children could stumble over a log and break a leg even though no sinful action put the log in their path. Those four gases may be just like the log in the path.

The four gases mentioned have two principal effects on the atmosphere of the earth. The extent of those effects and future trends are not certain. The two effects are a general warming of the atmosphere and a depletion of ozone in the upper atmosphere. For each of these effects, one gas is more important than the others; but none can be neglected. For the warming effect, carbon dioxide, which absorbs some of the light reflected from the earth (this is the "greenhouse effect"), is the gas which causes the most difficulty; for ozone depletion, the chlorofluorocarbon group is worse than the others. But both matters are extremely complex, and all four gases are involved in both problems.

What are the consequences of atmospheric warming and ozone depletion? One important consequence of the warming is partial melting

of polar ice, leading to an increase in sea level and flooding of coastal areas throughout the world; many large cities could be destroyed. Ozone depletion can allow harmful ultraviolet rays from the sun to penetrate the atmosphere, causing cancer and potentially harming all living things. The recent discovery of an "ozone hole" high over the Antarctic region has led some scientists to make gloomy predictions.

Which human activities increase concentrations of these four gases? None of these activities is sinful in itself; but were the long-range consequences of these activities examined early enough? Burning fossil fuels produces carbon dioxide. Some of the increase in atmospheric nitrous oxide is probably due to the general increase in the amount of nitrogen-containing fertilizer. (To illustrate the complexity of the problems, consider that another large-scale human activity, the destruction of tropical forests, *decreases* nitrous oxide production.) Atmospheric methane levels increase as the number of cattle increases; and it is probable that increased combustion of fossil fuel indirectly causes increased methane. Chlorofluorocarbons are manufactured for use as refrigerants in refrigerators, freezers, and air conditioning units; their use as solvents in certain industrial processes is also very important. Inevitably, with millions of gallons produced each year, some is lost to the atmosphere.

Although the increased concentrations of these four gases might not be serious, there is considerable evidence to the contrary. The scientific analysis is not yet complete. In fact, the analysis may not be complete until it is too late. Surely the possibility of danger from these four substances is enough to make the point that human scientific and technological activity can lead to great harm because of the universal human desire to solve problems without reference to the law of God, without a dependence on God to take care of his creation, including the human race. In any event, it may one day seem to human beings that the harmful ultraviolet rays from the sun, or the roaring waves engulfing coastal areas, are seeking out people, to chase them away, much as the Lord drove out Adam and Eve from the Garden of

Eden after they sinned. Perhaps some will cry out to the mountains, "Fall on us!" (Rev. 6:16)

(3) Many other dangerous human activities—besides war-making, bad industrial and agricultural practices, and harming our entire physical environment—are also related to greater modern scientific and technological achievements. I shall focus on three of these activities. Each depends upon advances in human understanding which in themselves honor God, but which human beings use to further the rebellion against God.

First, the existence of widespread sexual immorality is at least partly due to certain scientific advances. Consider the pill which prevents contraception. It has a legitimate use. But it is used illegitimately when it tempts people to fornication and adultery. Chemists have also developed drugs which effectively combat most of the venereal diseases. Abortion, always dangerous, is not quite as dangerous as it once was because of the availability of modern surgical techniques. It is almost certain that an abortion-inducing pill, developed using advanced chemical procedures, will soon be widely available. Perhaps a glimpse of the depth to which society has sunk is provided by considering that abortion is world-wide, and that every year between thirty and forty million abortions are performed. One does not have to be very perceptive to conclude that fornication and adultery and the accompanying misery are probably worse than at any other time in history.

Second, the unbelievable amount of drug abuse would not be possible had there not been several scientific developments. The amount of such abuse is much larger than generally realized: one observer reports that the people of the earth spend more on illegal drugs than on food. Thus, the annual production of thousands of tons of harmful drugs, such as cocaine, marijuana, and heroin, would not be possible without certain chemical technology, particularly the techniques used in purification of solids. Drug trafficking cannot occur without evading law-enforcing personnel, both within countries and during illegal crossing of international borders. As a result, drug traffickers

must possess sophisticated means of evasion, such as ships and planes using modern means of communications. Modern chemical advances, communications, and transportation used in producing and marketing drugs combine to increase the amount of drugs consumed. As a result, large numbers of persons are harmed. In other words, modern technology used by the drug trade is responsible for decreasing what human beings achieve.

Third, the damage done to the societies of the world by terrorists, aggressors, and dictators is immense: the amount cannot be comprehended. Terrorism and tyrannical governments are not new; but what they can do because of modern technology is new.

Some modern terrorists know enough chemistry to enable them to manufacture plastic bombs and letter bombs. Terrorists are no longer the highwaymen of old, armed with clubs or muskets. They possess the most advanced kinds of weapons. Not long ago several free world leaders, some of the most important people in the world, met in Tokyo. Terrorists launched a rocket aimed at their meeting place. The rocket was far off target; but one wonders how long it will be before a terrorist rocket and its launching mechanism will be good enough to destroy such a group of people. The chemical and engineering knowledge concerning the manufacture and use of liquid and solid rocket fuels has become available not only to legitimate agencies, such as those responsible for artificial earth satellites, but also to the revolutionary underground. It was always possible for treachery to change the course of history when revolutionaries killed heads of government. But the new thing is that modern science and technology, which exist in order that the Lord be honored, make the danger much greater than it has ever been.

Modern tyrants are worse tyrants because of modern technology. One cannot imagine a Caesar, a Napoleon, or a Czar keeping as close a watch on his subjects as does a modern tyrant. Electronic surveillance is almost commonplace. Furthermore, with the aid of computers, records of a person's behavior are much more easily available than was heretofore

possible. Computers introduce a new dimension to the concept of surveillance.

I shall describe one more link between modern tyrants and natural scientific achievement. The radio represents one of the more sophisticated developments in modern science and technology. The production of a signal in the appropriate part of the electromagnetic spectrum by a radio transmitter is possible only because of the modern understanding of the nature of matter and fields. The means whereby this signal is amplified and converted to sound by the receiver, the radio, is equally subtle. I need not dwell on the obvious misuse of radio (and, of course, television) by most of the world's societies in their daily social life. But I do want to call attention to the evil use to which tyrants have put the radio. In the 1950s Colonel Nasser, virtually the dictator of Egypt, used radio broadcasts to incite Arabs throughout the Middle East and prepare them for war against Israel. Nasser was quite correctly accused of being guilty of "aggression by radio." Without doubt, his success in this radio campaign was important in uniting Arabs against Israel, and therefore one reason for so much unrest in the Middle East even today, decades later.

What Will Happen? Examining the two themes in human history shows that an unbeliever's approach to life does not work. Attempts to live without God lead to defeat in human enterprises; but in spite of defeat, people continue to attempt to live without God as they continue the first sin of Adam and Eve. Repeated defeat leads to general frustration; and so it is no surprise that analysts on all sides speak of the misery of the human condition.

Notice my claim that this rebellious approach to life does not work. In the world which God created, it does not work to assume that he need not be served. God created a world which permits human beings to develop their potential provided they honor him. Scientific development reflects a certain harmony between a scientist and that which he or she investigates. Just as a scientist cannot expect to defy the law of gravity and succeed in scientific work, so also no society can defy God's will for creation!

and be a peaceful, harmonious society.

The human race cannot sustain a continued growth in the evil results of modern technology. Sometimes a very rapid growth rate is called "exponential growth." I shall digress to explain this concept because it explains well the growing evil effects of technology.

Exponential growth occurs when the amount of growth in any relatively short period of time depends upon the total amount of growth in all previous time. Consider, for example, the early stages of growth of an organism. Suppose it grows at the rate of one percent per day. Let us imagine a day in which it starts out with one thousand cells; at the end of the day it will have increased by one percent, or ten cells, so that it now consists of 1,010 cells. With continued growth, the organism will eventually consist of two thousand cells. Then in one day the organism will grow twice as much, by twenty cells, to 2,020 cells. Still later the daily growth will be many times ten cells. This kind of growth rate is an exponential growth rate. Scientific and technological knowledge grows in this way, since the amount of growth of scientific knowledge in some short period—say, a year—depends upon how much knowledge exists at that time. Thus, because there is always some misuse of new knowledge, the possibility of causing large scale destruction, perhaps destruction of most of human life, eventually occurs.

Civilization cannot sustain the increase in the number of people killed in a world war at the rate established by the two recent world wars—twenty million in the first, forty million in the second, virtually all by conventional warfare. Nor can we continue the practices, such as spewing out lead, which harm our environment extensively. Perhaps we can endure a little more aggression and terrorism; but it would be foolish to claim that we can absorb much more. We may be on the brink of massive damage done to the human race because of sexual immorality. What we have seen is exponential growth in the evils which have resulted from wrong uses of science and technology. It is not enough for one to claim that life has always

been difficult, and so it will be difficult in the future. Simple calculations show that life cannot go on indefinitely if present trends continue.

But the Lord is merciful. He did not destroy Adam and Eve when they sinned. He did not destroy the world, but saved a few, at the time of the Noahic flood.

Let me summarize concerning what may be happening in human history with respect to the two themes which run through human history. The Lord sometimes uses the distortion of human development to be the means of holding off the worst results of that development. Consider what has happened with respect to nuclear bombs. Upon first examination, the situation seems hopeless. One might conclude that in a short time we will all be incinerated or killed by nuclear radiation. Yet no doubt the existence of these bombs has held off the third world war of the twentieth century. Certainly one cannot claim that our system of international relations has improved enough to make such a war less likely. On the contrary, it seems that the governments of the world are becoming more greedy and less responsible. Yet there is a universal fear of world war because such a war would surely be a nuclear war. Perhaps the Lord is waiting for the nations of the earth to repent.

It is instructive to observe how unbelievers have responded to the possibility of nuclear annihilation. For generations it was widely believed—if one did not accept biblical prophecy—that the human race would last forever. Now that the means whereby the human race could be destroyed is visible to all (I do not claim that the Bible predicts a nuclear holocaust), unbelievers have suddenly come to accept what Bible-believers have always known: the world will come to an end. This realization is terrifying for those who do not expect their Savior to return victoriously.

There is hope for the children of God. Human development has not been meaningless. History has meaning. The redemption theme in human history, the development of human potential, is taking us to the time when we will have a perfect life with the Lord.