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"The fear of the Lord is the beginning of Wisdom." Psalm 111:10

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The June 1969 issue of the *Journal* is the first to show the new color-coding system adopted to differentiate the four quarterly issues. The March issue will continue to show the traditional blue, June will be green, September brown, and December red. We hope you will enjoy and approve this dash of color changing with the seasons.

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JOURNAL OF THE AMERICAN SCIENTIFIC AFFILIATION

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Where It's At

The greatest challenge to Christian faith on the interface of science and Christianity today can be summed up in the single sentence, "Man is Only a Complex Machine." And in that sentence, the challenge resides in a single word, "Only."

This is where the action's at. Even evolution, long regarded as the major threat to Christian faith from science, pales into insignificance by comparison. If modern science can maintain that man is only a complex machine, it really doesn't matter how he got that way.

Much of modern culture in its desperation and its excesses derives from the acceptance of the thesis that man *is* only a complex machine, an acceptance viewed as final because it is presumed endowed with the authority of science. Attempts to break through this "inevitable" rational conclusion by some type of irrational self-authentication multiply.

Does modern science require us to accept that man is only a complex machine? That all of life and personality is reducible only to the laws of physics? That's where it's at. We ought to be in there.

man is only a complex machine

Man on a Spaceship*

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THE KEY TO THE TWENTIETH CENTURY

Natural History

The earth, in common with the other planets of the solar system and the sun itself, was formed by condensation out of a gravitationally collapsing cloud of gas and dust some 4,600 million years ago. Its history since that time has almost certainly been much richer than that of any of the other planets. It is probable that all of them initially had rather extensive atmospheres of hydrogen, ammonia, and methane, the same as those still retained by the major planets Jupiter and Saturn. During the first one or two billion years of the earth's history, the action of ultra-violet radiation from the sun on this atmosphere, combined with electrical discharges within it, produced free radicals of nitrogen and carbon with hydrogen. Reactions of these energy-rich free radicals with methane and ammonia then produced a variety of amino acids and other basic organic components of living systems. These processes must have occurred to some extent on all the planets in their early history.

Gradually the smaller planets, including the earth, lost their primordial atmospheres through escape of hydrogen from their gravitational fields. Through volcanic activity a great deal of water of crystallization was released, and the earth acquired its oceans. As the oceans grew in volume, the organic materials produced out of its shrinking original atmosphere accumulated within them. The combination of these materials with phosphoric acid and dissolved ammonia in the primordial ocean produced in time, by processes not now understood, the elementary components of living systems. The earliest evidence of life that we have at present comes from the Gunflint Iron Formation on the north shore of Lake Superior near Schreiber Beach, Ontario. A chert in this formation, whose age is 1,900 million years, contains the fossils of many single celled microorganisms somewhat like modern algae. Thus cellular life had developed in the oceans two billion years ago.

Very slowly through photosynthesis these organisms replaced carbon dioxide in the atmosphere with free oxygen. In time the oxygen built up sufficiently to produce an ozone layer in the upper atmosphere which thereafter has effectively shielded out the intensive ultraviolet radiation from the sun. As a result of this and other changes in the environment, the evolution of life took a new turn some 600 million years ago. Geologically the period is known as the Cambrian. In it the evolution of a variety of multicellular organisms was initiated and elaborated. The earth began to acquire a biosphere. By 300 million years ago the land was well covered with vegetation and populated by land reptiles and insects. In this period the great coal beds and oil fields of the earth were laid down.

Man in the form of our biological species *Homo sapiens* is one of the most recent to appear on the planet, arriving a mere thirty-five thousand years ago. During the first thirty thousand years he had very little effect on the balance of nature on the earth, over and above the effect which the introduction of any other new species had on it. The emergence of human civilizations, of cities and empires, literature and science, has all taken place in the last five thousand years. Even these developments, however, left vast areas of the earth largely untouched by man.

Our century, the twentieth, is unique in the whole history of our species on the planet, and indeed in the whole incredibly longer history of the earth itself. There is nothing in these previous histories to which it can be compared. We find ourselves in the midst of revolutionary changes of a magnitude and scope far beyond that of any other cataclysm which the earth has experienced throughout its billions of years.

The Genesis Summary

A remarkably applicable key to these questions is found in a summary statement at the end of the first chapter of Genesis in the Bible. Although this chapter is based on the prevailing Babylonian cosmology of the fifth century B.C., the summary at the end of it relating to man is, as we shall see, remarkably applicable to our present concern. This summary occurs with considerable repetition in verses 26 through 28. "So," it begins by way of definitive summation, "So, God created man in his own image and blessed them and said to them: 'Be fruitful and multiply and fill the earth and subdue it; and have dominion over

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the fish of the sea, and over the birds of the air, and over the cattle, and over all the earth.'" This remarkable statement about man and his destiny in the earth has waited thirty-five thousand years to reach fulfillment, but is now with breathtaking speed being realized before our eyes. Only in the twentieth century has it been at all true of man's status on the earth. In it we can find a key to the meaning of the twentieth century.

Have Dominion Over the Earth

All during the intervening twenty-four hundred or so years since this summation was written, it has not been really descriptive of man's status in the earth. Vast areas, even whole continents, of the earth's surface were only sparsely if at all settled by man. Man thought consciously of himself as a minority species among many other species. Human settlements were for the most part tiny islands in the midst or on the edge of vast forests or jungles in which the wild beasts held sway. He exercised a limited dominion over his own flocks of sheep, herds of cattle, horse, and dog. But always there was danger and uncertainty as ever-watchful tigers or wolves lurked in the shadows ready to pounce at the first opportunity. He exercised no dominion over two basic essentials, the world of microorganisms and the fertility of the soil. Pestilence, plague, and famine were ever-present threats periodically actualized in terrible scourges before which man stood helpless. Since he was bound to the earth's surface, the birds of the air remained beyond his reach. For all his cleverness as a fisherman and sailor, the sea remained vast and alien in which creatures large and small disported themselves oblivious of man and his ways. The dominion over the earth exercised by man was token and symbolic at best, and he was very, very far indeed from having subdued the whole earth to his purposes.

Be Fruitful and Multiply

Man had been fruitful through previous centuries, but disease and famine prevented him from multiplying. At the beginning of the Christian era there were only about 300 million human beings on the earth. It required seventeen centuries to double this number to 600 million. Then in 1820, for the first time, the world population of species *Homo sapiens* passed the one billion mark. By 1930 it had doubled to two billion. Just a few years ago, in the early sixties, it passed three billion. By 1977 it will have reached four billion, by 1990 five billion, and by the end of this century, in the year 2000, it will be well beyond six billion, and the world will be just twice as crowded as it is now. Clearly our century, the twentieth, is the one in which the biblical injunction to be "fruitful and multiply and fill the earth" is at last being fulfilled. It is true of no other time in history. To us and to our generation the lot has fallen to experience the fulfillment of the purpose asserted for man when he began to inhabit this planet thirty-five thousand years ago; namely, that he should in the fullness of time multiply and fill the whole earth. It is a startling thought.

Subdue the Earth

But the same century, the twentieth, marks the fulfillment of the rest of the injunction as well. There are many living today whose childhood was spent in the first decade of this century before the advent of either the automobile or the airplane, electric lights or appliances, radio or TV. In just the span of a single life time they have seen the whole face of the earth transformed by the phenomenon of technology. A jet flight over almost any part of the earth today provides striking evidence of this transformation. Everywhere the fields and highways, factories and cities of man stretch endlessly in every direction. The great primeval forests of the earth are rapidly shrinking and by the end of this century will have essentially disappeared. This is true not only of the developed portions of the earth—Japan, America, Europe, and Russia—but of those areas we consider underdeveloped as well—Asia, Africa, and Latin America. Even where the people continue economically depressed, technology in the form of steel mills and factories, highways and airports, dams, power plants, and machinery is everywhere in evidence. In this century man has not only filled the whole planet but he has subdued it as well and taken effective dominion over every creature.

The End of Wilderness

In recent years wilderness and wildlife societies have been formed with a sense of panic about them. Even in Africa, which we still think of as a continent teeming with wild and exotic animals in a natural state, the true situation is one of the rapidly approaching extinction of many species. With the best that these societies, or any of us, can do, by the end of this century the only wild animals left on the earth will be found in zoos or scattered national parks maintained by man for their protection. All the rest of the planet will be devoted directly to man and his needs: to the production of his food and of the water and energy to do his work; his vast cities and the system of highways, air lanes, and seaways linking them together; his recreation and pleasures, foibles, fancies, and vanities. Occasionally he will visit a zoo or a wildlife preserve and sense the pathos of a vanished world before man took his God-given dominion over it, and feel a sharp nostalgia for the earth as it was before man filled it and subdued it. Over all the rest of the earth every square inch of arable land will be devoted to human agriculture in which all that grows and moves will be specially selected crossbreeds far removed from the wild varieties which covered the earth before man began to exercise his dominion over them. All that lives will be especially suited to the needs of man; any creature which fails to meet this standard will be bred out of existence. Yet this vast change in the status of living things on this planet is the work of but a single century in the whole 4,600 million-year history of the earth.

THE EARTH AS A SPACESHIP

Thirty-Three Years To Go

We have just thirty-three years to go in this century. It is a dreadfully short period in which to accommodate ourselves to the things which are so rapidly coming upon us, and to accomplish all that must be accomplished for man to continue his existence on the planet at any reasonable standard of living. In this brief period technological and social changes must somehow be achieved which dwarf in magnitude all others which have occurred in our past history and which have been accomplished over much greater time

spans. It has become of the utmost importance for all of us to see as clearly as possible the character, direction, and challenges of the revolution through which the earth is passing.

The most effective image I have found for this purpose is based on recognizing that the earth is fast becoming a spaceship carrying mankind on a long journey through space. I am indebted to Kenneth Boulding for this image, which is partly developed in his important and stimulating book, *The Meaning of the Twentieth Century.*[1] Recently the British economist Barbara Ward has employed this same image most effectively in a book entitled *Spaceship Earth.*[2] Now that our astronauts completely encircle the earth in less than two hours, and the rest of us can get jet flights to almost any part of the earth in twelve hours, we have all come to see the earth as small enough and compact enough to be thought of as a spaceship. The atmosphere of the earth is an ideal radiation shield, transparent to light, but very effectively shielding us from the fierce ultra-violet, X-rays, and higher energy radiations of outer space. In this the earth fulfills admirably one of the primary requisites of a well-designed spaceship.

During its long prehuman history, the earth has been prepared with a wealth of supplies now required by man, when he has filled the earth and subdued it, to carry him on his long journey through space from now on. Over long stretches of its geologic history, the processes which have concentrated ores of iron, copper, uranium, and other vital metals have by now well stocked the earth with them for man's requirements. Later in its history coal beds and oil fields were laid down slowly over 100 million years to provide vast reserves of fossilized fuels for man's utilization, primarily in the twentieth century and after. It is as though some hidden designer had been at work for the last billion years or so specifically preparing the earth to become the spaceship for this creature who is now rapidly filling the earth and subduing it to his own uses.

Spaceship Requirements

There are several fundamental requirements for a satisfactory spaceship. First it must have an adequate source of energy which will last throughout the trip. Next it must have an adequate food supply or means of producing food for the crew throughout the journey. The air and water reserves in the ship must be kept pure and adequate for all needs. Wastes must be reprocessed or disposed of in ways which will not contaminate the ship. And, finally, the crew must not be allowed to increase in numbers, and it must remain unified throughout the journey. Divisions into warring rival subcrews or interpersonal conflicts between crew members would be catastrophic in a spaceship on an extended voyage.

Energy and Water

All these elements of a spaceship economy face us in a particularly acute form as we move into the last third of this century. Consider first the basic requirements for energy and water. These are interrelated, and the key to both is nuclear energy. As we consider the vast requirements which face us in the immediate future, it seems remarkably providential that man should have stumbled on nuclear energy and the possibility of its controlled utilization less than thirty years ago. Although, spurred by the terrible threat of Hitler's Nazi Germany, it was first developed destructively, its discovery has come barely in time to make our continued occupancy of our spaceship possible.

Until only a dozen years ago, man was exclusively dependent on chemical energy (with the minor exception of hydroelectric power) derived from the burning of fossilized fuels, such as coal, oil, and natural gas, with the oxygen of the atmosphere. This form of energy is exceedingly rare, even esoteric, in the universe as a whole. There are very few spots other than the earth in the entire universe where the necessary ingredients for such energy can be found. Nuclear energy, on the other hand, is extremely common and universally present throughout all creation. Our sun is a natural hydrogen bomb in process of continuous explosion and so are the other so-called "main sequence" stars. Our galaxy, the Milky Way, contains some hundred billion such stars, and all the other galaxies are equally thickly populated with them. God has made more hydrogen bombs than He has anything else. There is nothing more common or more natural and universal in all creation. In the fullness of time it was inevitable that man in the fulfillment of the promise made at his creation would come to exercise dominion over this universal element of nature as well.

To us and to our generation the lot has fallen to experience the fulfillment of the purpose asserted for man when he began to inhabit this planet thirty-five thousand years ago; namely, that he should in the fullness of time multiply and fill the whole earth. It is a startling thought.

Most discussions of nuclear energy today seem to miss completely this natural character of it. Instead it is discussed as though it were a purely human invention, something introduced into the scheme of things by human technical ingenuity but not intended to be contained in the world as God prepared it for human habitation. Moreover, such discussions tend to concentrate almost exclusively on its destructive aspects as though its only role in human affairs were that of placing upon man the terrible burden of our arsenals of nuclear weapons. Both of these views represent a dangerous distortion of the true situation. Hydrogen, lithium, thorium, and uranium are natural, pre-existent fuels just as much, if not more so, as are coal and oil. In the same way gasoline can be burned in a controlled manner to produce useful energy or made into napalm bombs for destructive purposes. Like everything else in nature over which man exercises dominion, he can exercise it either for a blessing or for a curse. This is the true status of nuclear energy.

The true role of nuclear energy for man becomes abundantly clear when we consider the post-revolutionary status of man on this planet in the twenty-first century. With the earth then supporting a total population in excess of seven billion human beings, we are forced to contemplate a radically different world from

the one we knew before the revolution in the midst of which we now find ourselves began. To support such a population in a continuous and stable way will require an immense consumption of energy on a scale far greater than any we have seen so far. It will also require vast quantities of fresh water, mainly for irrigation of great desert areas of the earth not previously required for agriculture. Both the requirements for energy and for water can be met only with nuclear energy. We have already reached the danger point with water, and soon it is inevitable that we shall see more and more large nuclear-powered desalinization plants constructed along ocean shores all over the earth. Whether we burn the rocks (by extracting uranium for nuclear fission reactors) or burn the sea (by extracting deuterium for thermonuclear power plants), adequate reserves of nuclear fuels are available in the earth for many millenia. Coal and oil will be carefully husbanded and burned as fuel only for small mobile power systems, such as automobiles and airplanes. For electric power, desalted water, and space heating, nuclear power will be universally used. There is no other long-term alternative.

Thus by the end of this century nuclear power and sea water desalting plants will be commonplace in every country of the world. This is an essential requirement for the maintenance of the population which the earth will then be sustaining. Considerations such as these show how essential to human welfare it is that man should now be exercising his God-given dominion over nuclear fuels. In retrospect it is providential that the key discoveries which make it possible for man to use nuclear energy were made just when they were. Otherwise we would be facing the gravest problems of human survival on the planet for a period just a few decades away from the present. The blessing which man derives from his exercise of dominion over nuclear fuels is far greater and more crucial than has been generally realized. On the other hand, the corollary wide-spread distribution of nuclear fuels among all countries large and small is charged with terrifying possibilities. By the end of the century nuclear fuels are bound to be as common and universal as coal is now. In such a world *any* country large or small can fabricate these plentiful fuels into nuclear weapons at any time it wishes to. The problem of proliferation of nuclear weapons which so concerns us now will appear very different then. The specter of vast destruction in a nuclear holocaust can only grow more acute as time goes on. This too is an essential aspect of man's exercise of dominion over nature. We cannot have the possibility of blessing without the possibility of curse. Since it is man who exercises the dominion, it is man alone who determines whether it will be made a blessing or a curse. Hydrogen and uranium are inert. Like alcohol, dynamite, or morphine, they can be applied to either end by him who exercises dominion over them.

Food

The need for water is closely tied in with the need for food. We are already running dangerously short of food for the world's explosively increasing population. The vast surpluses of grain and other staples which have plagued our agricultural system in this country for so many years are now gone. We will never see them again. Instead, restrictions on land under cultivation will be rapidly removed in the next few years, and the United States and Canada will be shipping greatly increased tonnages of grain and other foods to India, Pakistan, and China, and perhaps for several years to Russia as well. At the same time extensive increases in world fertilizer production which are already under way will be accelerated and the productivity of land in these countries which is already under cultivation will be greatly increased. All of these steps, however, will be adequate for not much more than another five years or so. To prepare ourselves for double the population at the end of this century, we must between now and then add an average of some thirty million acres of new land each year to that already under cultivation. Since most of this new land must come from desert areas of the earth's surface, we must arrange to supply it with about twenty billion gallons of fresh water per day, and we must add this much new water supply each year.

It is as though some hidden designer had been at work for the last billion years or so specifically preparing the earth to become the spaceship for this creature who is now rapidly filling the earth and subduing it to his own uses.

This is a staggering requirement, but we at Oak Ridge are convinced that it is now technologically feasible. The Oak Ridge National Laboratory has developed a prototype nuclear power reactor, the molten salt reactor, which promises to provide abundant energy at very low cost. The Laboratory is also the major center in the United States for research and development of nuclear desalinization plants. With very large-scale installations, it is technically feasible to produce several billion gallons of fresh water from the sea per day at a cost comparable to that for present irrigation water, with associated large-scale production of electric power at costs well below those of TVA today.

Nothing we do in nuclear desalinization of the sea will compare, however, with the evaporative power of that natural nuclear power plant, the sun. The action of the sun generates a known supply of 14 million billion gallons of fresh water per day which is twenty-five times the requirement of a world population of six billion people. This supply, however, is distributed very unevenly for agricultural purposes. To utilize even a small portion of it will require major engineering projects. One such project diverts three rivers in Australia which used to flow to the coast and into the sea through tunnels through the Snowy Mountains where they will irrigate arid valleys in the interior and generate two and a half million kilowatts of electricity in addition. In this country the diversion of the Colorado to the Los Angeles area, the Imperial Valley, and Mexico is under consideration, together with the huge Feather River project in northern California.

The most ambitious project of this sort would reverse the flow of rivers in northern Canada, which now flow into the Arctic Ocean, so as to provide 160 billion gallons per day to the western deserts of the United States and Mexico. Russia may in time

reverse the flow of the Ob, the Lena, and the Yenisei rivers to supply tillable but arid regions there. Similar major projects are possible in China.

Given sufficient time, the dominion which man already knows how to exercise over the earth seems adequate, therefore, to provide food for a population of around ten billion people or even more. But the tragedy of the present decade is that we do not have time enough to carry out such projects before large-scale famines will set in. By 1970 famine of catastrophic proportions seems inevitable in India, Pakistan, and China. It will be a calamity unparalleled in human history, involving death by starvation for numbers running into the hundreds of millions. We have somewhat longer in South America, but, unless major projects can be initiated in the next few years, famine of comparable proportions will occur there by 1980. These are some of the realities of our filling the earth and trying to achieve the means in such a short time to subdue it and convert it into our spaceship. In the long run, say thirty or forty years, we have the technological means to provide enough food. But the immediate needs are so pressing and are increasing so rapidly that there seems no possibility of avoiding short-term catastrophe.

Waste Disposal

Another spaceship requirement which is already becoming crucial, particularly in the United States, is the necessity for adequate reprocessing and disposal of all wastes. Air pollution, particularly in Los Angeles and New York, has become a problem already of crisis proportions. The pollution with industrial and human wastes of our rivers and lakes has reached such levels that vigorous national programs of control seem to be imminent. In another ten or twenty years, however, the same problems will plague the whole earth. Rapid world-wide industrialization will soon persuade all nations that this is a planetary, not a local, problem. The earth is a single spaceship with a single atmosphere and single water system. With a population over double that presently on the earth, waste reprocessing and pollution control will have become recognized planetary necessities requiring a world-wide system of controls.

Here again the technological means for achieving adequate control of atmospheric and fresh water purity are either available now or seem assured in the next ten years. Most of the industrial effluents now fouling our rivers and lakes could be processed with equipment already on the market to recover and process chemicals and pay off the initial capital investment in three to ten years. Air pollution from industrial and utility plants can be similarly controlled, although at some additional cost. In time fuel cells or improved rechargeable batteries must replace gasoline for automobiles and trucks. The whole problem is now more political and economic than technical. Its solution threatens deeply intrenched interests and firmly established patterns, and so will be accompanied by considerable social and political stress and strain. But the ultimate demands of a spaceship economy will in time force a solution.

Population Explosion

These problems of energy, water, food, and waste handling arise from and are created by the explosive increase in human population which is now going on. As we have seen, in the remaining third of this century man will have fulfilled the biblical injunction to be fruitful and multiply and fill the earth. But an inescapable corollary of this injunction faces us now with terrible urgency. Because the earth is in fact a spaceship for man's journey, it is essential that once the earth has been filled by man, he must stop being fruitful and cease further multiplication. Moreover, this must be accomplished within a generation, or certainly within no more than two generations. The children of today's college graduates must, as they approach adulthood, already have started the process which their children must complete; namely that of separating human sexuality from procreation. All over the world this process will involve a profound religious and moral readjustment. Yet there is no viable alternative to such a transformation. What God required of man during the long centuries before he filled the earth is quite different from what He will require of man after he has done so. This seems clear enough. Once the crew of the spaceship has reached its full complement, there is an absolute requirement that it not be allowed any further increase. Yet no other requirement calls for such a deep-seated readjustment in long-established religious, moral, and social patterns, or is more resolutely resisted by mankind.

The children of today's college graduates must . . . already have started the process which their children must complete; namely that of separating human sexuality from procreation. All over the world this process will involve a profound religious and moral readjustment. Yet there is no viable alternative.

This problem of achieving a stable human population on the planet dwarfs all others in both urgency and difficulty. Yet one way or another it must and will be achieved. I am fearful that only after famines of awful proportions and their accompanying social paroxysms will sufficient pressure have been brought to bear to force men to a solution. But there is no other way out. In the end sometime in the twenty-first century, and hopefully early in the century, a stable planetary population will have been achieved at somewhere between six and ten billion human beings. When this has been done the requirements of that population for energy, fresh water, food, and pure air can and will be met, although most of the intellectual energy and scientific and technological skill of humanity will be absorbed by this task.

Unity in the Crew

The last, and certainly the most difficult problem in achieving a satisfactory occupancy of our spaceship, is the requirement of unity in the crew. It is to this aspect of the problem that Barbara Ward's book, *Spaceship Earth*,[2] to which we have already referred, is devoted. When we consider the vast social and political problems which presently confront mankind, the ultimate unification of man on the planet which

must somehow be achieved seems almost unattainable. There are radical conflicts in ideology dividing the world into two vast armed camps. As we crowd closer together on the earth the way must, and, I feel confident, will be found for holding these ideologies in some kind of creative balance. Other tensions arising out of deep historic hurts maintain local conflicts in the Middle East, Southeast Asia, among African tribes, and elsewhere on the earth. America and South Africa are powder kegs of racial tension between white and black. Doubtless the achievement of what Barbara Ward calls a "balance of ideology" will involve paroxysms along the way of an intensity greater than any we have so far known. But each will, I believe, bring us closer to that unity which our spaceship status requires. Each of these adjustments will involve, as Miss Ward so fully describes, a move toward a "Balance of Power" and a "Balance of Wealth" in addition to the balance of ideology. All represent drastic changes in the world of warring nation states, of haves and have-nots, which we know now. Yet her searching analysis of all these problems does lead to a kind of guarded optimism about the ultimate outcome.

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[1]Kenneth E. Boulding, *The Meaning of the Twentieth Century* (New York: Harper & Row, 1965).
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Environmental Control*

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Our species has faced several critical problems in its evolution: pandemics, exhaustion of readily available sources of food, fuel and other materials, inefficient and slow transportation and communication systems, and so on. When these problems were acute, the probability of a human being surviving to old age was low; consequently, population death rates were in balance with population birth rates, and the world population of human beings grew very slowly. Sometimes, as in Europe in the 14th century, over large areas and for extended periods, life was so rigorous that populations actually declined. Until the last two centuries, man faced such serious problems on this planet that he was a relatively unimportant factor in the overall scheme of life. However, now that the important problems of the past have been solved, a new group of problems has arisen, perhaps potentially more deadly to the continued life of our species on this planet.

The Central Challenge

The central problem is that with a relaxation in man's struggle for simple survival, there has been a drop in death rates all over the world, unaccompanied by corresponding drops in birth rates. The result is the well-known population explosion. What is not nearly so well known is the precise dimension of the problem. Even experts on population problems are guilty of statements to the effect that the human population is "growing exponentially," or "doubling every 30 years." Both these statements imply the same thing: that the human population is growing at any instant at a rate proportional to the world population size at that instant. In fact, this is not the case: we are growing at a much faster rate. In 1960 three engineers predicted that humanity would squeeze itself to death in 2026; nobody paid much attention. Even fewer seem to have noticed that subsequent data from the United Nations have shown their predicted growth rates to be badly underestimating current growth rates. What can scientists and concerned laymen do? First, support birth control programs, particularly in newly developing countries. Second, speak out firmly against the notion that a man is not a real man unless he has several children. Experts on the population problem insist that physical birth control devices are not the

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basic problem. The basic problem exists in the minds of the people who are not disposed to use contraceptive measures even if they are available free until they have had three or four children.

Many other problems are a consequence of human population explosion and the massive resultant effect our species is having on everything which occurs on this planet. Five problem areas in particular merit much more exposition, and are dealt with briefly here.

Can the Sea Solve the Food Problem?

One particularly dangerous notion ingrained in our popular culture is that the sea is an inexhaustible source of food, and indeed everything else. The facts speak differently. First, much of the world's oceans are aquatic deserts, relatively poor in minerals and therefore supporting little plant or animal life. Second, much of what we remove from the ocean is high up on the food chain: we eat fish predators that eat small fish that eat crustaceans that eat plankton that derive their energy from the sun. At each step in this chain, there is tremendous loss of energy. The efficiency of the whole process is extremely low, comparable to that of growing grass to feed to rabbits which are eaten by lynx which are then eaten by mountain lions, which are then eaten by man. Man in fact does nothing comparable to this on land, either eating plants directly, or herbivores which eat the plants. In Asia, particularly, even the herbivore step is too costly, and most people live on an almost entirely plant diet.

Some people will counter this argument by insisting that man will some day live on the algae in the ocean. The central difficulty here is that many algae exist in the water at such low densities that much pumping and sieving would be required to extract useful quantities. If the number of calories required to extract 100 calories worth of algae from the ocean is too high, then the cost of the process in energy is exorbitant, without regard to the cost in money. The only parts of the oceans rich enough in minerals to support dense plant and animal concentrations of economic consequence are close to the continents; it is precisely these parts of the oceans we are polluting and degrading most rapidly.

Can We Survive Pollution?

Many forms of pollution are by now sufficiently well known to require no further mention. Pesticides are in this category. Anyone who has lived on the shores of Lake Erie for at least 30 years will require no further discussion of what this species is doing to his environment. New Yorkers for whom the Hudson River is a resource of limited usefulness presumably also fall into this category. However, man is polluting this planet in more important and more subtle ways which are in dire need of open discussion. Two important recent incidents have alerted the population to hazards of petroleum products being released at sea. The incidents aroused wide interest, because the fractions released were in enormous quantities and were swept to, or close to shore. However, ocean-going vessels routinely clean themselves at sea by flushing out a viscous fraction of crude petroleum left behind after the lighter fractions have been refined off. This heavy fraction is called bunker fuel, and in the cold north Atlantic in winter has a very destructive effect on sea birds that become trapped in it (viscosity increases with decreasing temperature). Millions of birds are thus killed every year. The significance of this is that the sea birds' feces (guano) rich in essential minerals aid in circulation of chemical elements in the ocean which are the basic input to the cycle which terminates in commercial fish stocks.

Pollution of the air is probably the most serious pollution problem and will probably have the widest array of types of (often surprising) effects. There is considerable evidence that air pollution has implications for the weather, for human health, for growth of agriculture plants and animals, and indeed for almost any imaginable chemical process on this planet. It is not widely recognized that the total quantity of air which determines the entire course of events on this planet is not very great: most of it occurs in a sphere seven miles out from the earth's surface. Man is now in a position to have a very major effect on this volume of gas. A regular jet traveller will have noticed, for example, that jet contrails are a major contributor to the origination of clouds at certain altitudes and in parts of North America. Very interesting time lapse motion pictures which have been taken of the Los Angeles Basin throughout a typical day by strategically placed cameras distributed around the basin show dramatically what a major effect man is having on the air that supports him and his civilization, and all life on earth.

What can scientists and concerned laymen do? First, support birth control programs, particularly in newly developing countries. Second, speak out firmly against the notion that a man is not a real man unless he has several children.

Those of us fortunate enough to live in thinly populated parts of this country find it a trying ordeal to visit the large manufacturing cities of the northeast and the midwest, because of the oppressively poisonous-smelling air. Unfortunately, an increasing proportion of the U.S. population is becoming adapted to living in this air, and tolerating sinus operations, rapidly rising emphysema death rates, lung cancer, and all the concomitant hazards. Unfortunately, *Homo sapiens* is a remarkably adaptable species, so much so that we may have adapted to our ultimate doom before we are aware that it is upon us. The time has come to cease adapting, and speak out vigorously about the contamination of the environment before it becomes uninhabitable.

Ironically, much of the material with which we are destroying the planet could be very useful as input for various factory processes. This is true of smoke, wood chips, beer cans, abandoned cars, newspapers, and most solid-liquid waste. Massive, aggressive research programs on techniques for reclaiming solid and liquid waste should be initiated before exhaustion of our mineral wealth, forests, and fossil fuels forces us to such massive efforts on a crash basis. It has turned out that corporations devoted to such reclamation can be remarkably profitable.

Is Disease Really Being Conquered?

Man's thinking with respect to disease has gone through tremendous changes. Examination of the diaries of people who lived a few centuries ago shows that epidemics and pandemics were rarely far from their minds. Peter Kalm, the Swedish naturalist, in 1748 was impressed by the prevalence of malaria in the United States. With the single exception of influenza, no disease has had an important effect on the history of western civilization in this century. Previously, epidemics wiped out up to 25 percent of the population of an entire continent, and were probably a major determinant of the outcome of all battles and wars. (Up to this century, a majority of the deaths in wars were due to disease, not wounds; since the incidence of disease could be very different in two opposing armies, depending on the sophistication of sanitation measures, the winning side was often that with the most healthy soldiers ready to do battle. This matter has been analyzed largely by historically-oriented epidemiologists, rather than epidemiologically-oriented historians, who are a rare breed.)

However, disease may soon return to its original place as one of the central objects of man's attention. An important ,but little known theorem of mathematical epidemiology holds that for every disease there is some threshold level of population at which the disease breaks out spontaneously, which is inversely proportional to the infectivity rate. That is, for any given disease, as sanitation practices which minimize probability of infection improve, the threshold population density for the disease rises. However, there is a lower limit below which the infectivity rate cannot be dropped further. Thus, there is an upper limit beyond which the threshold population cannot be raised. If these notions are correct, then as human populations become more and more dense, we will reach the threshold densities for more and more potentially pandemic diseases. Thus, the old enemies of mankind such as plague and typhus may be back again, with some important new enemies along with them, such as dengue fever. A careful observer of news from Vietnam and other parts of southeast Asia may be given pause for thought by these ideas. The point is that ever-increasing human populations are a mixed blessing, and before long, the blessing may be outweighed by the other part of the mixture.

Can Novel Forms of Agriculture Be Used?

Every time European settlers moved elsewhere, they had available alternative courses of action, although it is only in the last six years that it has been widely recognized that the alternative existed. One possibility was to transplant European style agriculture, built around conventional grains, and standard breeds of cattle, sheep, pigs and goats. This was the option invariably chosen. The other alternative was to set up intensive and scientific harvesting of native plants and animals, such as bison, kangaroos, antelopes, etc. Native organisms have often been totally or almost wiped out, then replaced by imported species. Now if it is true that natural selection selects a given place for those species and strains which, because they are best adapted there, make most efficient use of incident solar radiation, then man has been guilty of a very foolish mistake. Organisms which make best use of resources in a particular habitat have been replaced by other types which are not so efficient, as when buffalo (bison) were replaced by Shorthorns and Herefords in the American West. Data bearing on this point have become more plentiful recently. It turns out that in Africa, for example, higher quantities of meat can be produced per annum off a given acreage by harvesting 13 species of native game than by harvesting conventional livestock. Perhaps even more important, much of the native game produces higher quality meat. Critics of this argument will assert that buffalo meat, for example, is inedible. This would have come as interesting news to many of the early American settlers who somehow consumed about 1,300 pounds of the stuff per person per annum, every year of their lives.

The moral of this story is: don't change anything until it has been conclusively demonstrated that the change is for the better. Mother Nature has produced her results after a rather long sequence of experiments, and it may take considerably more sophistication than we sometimes realize to improve on her work.

Are There Significant Hazards in Pest Controls?

As human populations become ever larger, it becomes more important that agriculture be as efficient as possible. Pest control needs very critical reexamination, for this reason. The public should look carefully at any pest control campaign and ask the following question: in the season following the season in which we made an intensive effort to control a particular pest, were there as many pests as the previous season, or more, or less? If the number of pests in the season following treatment was equal to or greater than the number preceding treatment, then something is wrong. One does not have to be very observant to realize that this is often the case. Further, criteria for successful pest control campaigns are repeatedly being established by those campaigns which are successful; e.g. the Florida screwworm program, which eradicated the screwworm. A program which purports to be successful must gradually reduce densities of the pest, or the public is being deceived. The fact is, there are a very large number of types of pest control strategy now available, and if a pest control campaign does not gradually reduce pest densities from one year to another, it simply means that the program manager chose the wrong method; the people who pay them should then feel free to point this out.

The Historical Roots of Our Ecologic Crisis*

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Introduction

What people do about their ecology depends on what they think about themselves in relation to things around them. Human ecology is deeply conditioned by beliefs about our nature and destiny—that is, by religion. To Western eyes this is very evident in, say, India or Ceylon. It is equally true of ourselves and of our medieval ancestors.

The victory of Christianity over paganism was the greatest psychic revolution in the history of our culture. It has become fashionable today to say that, for better or worse, we live in "the post-Christian age." Certainly the forms of our thinking and language have largely ceased to be Christian, but to my eye the substance often remains amazingly akin to that of the past. Our daily habits of action, for example, are dominated by an implicit faith in perpetual progress which was unknown either to Greco-Roman antiquity or to the Orient. It is rooted in, and is indefensible apart from, Judeo-Christian teleology. The fact that Communists share it merely helps to show what can be demonstrated on many other grounds: that Marxism, like Islam, is a Judeo-Christian heresy. We continue today to live, as we have lived for about 1700 years, very largely in a context of Christian axioms.

Impact of Christianity

What did Christianity tell people about their relations with the environment?

While many of the world's mythologies provide stories of creation, Greco-Roman mythology was singularly incoherent in this respect. Like Aristotle, the intellectuals of the ancient West denied that the visible world had had a beginning. Indeed, the idea of a beginning was impossible in the framework of their cyclical notion of time. In sharp contrast, Christianity inherited from Judaism not only a concept of time as nonrepetitive and linear but also a striking story of creation. By gradual stages a loving and all-powerful God had created light and darkness, the heavenly bodies, the earth and all its plants, animals, birds, and fishes. Finally, God created Adam and, as an afterthought, Eve to keep man from being lonely. Man named all the animals, thus establishing his dominance over them. God planned all of this explicitly for man's benefit and rule: no item in the physical creation had any purpose save to serve man's purposes. And, although man's body is made of clay, he is not simply part of nature: he is made in God's image.

Modern Western science was cast in a matrix of Christian theology. . . . . Somewhat over a century ago science and technology—hitherto quite separate activities—joined to give mankind powers which, to judge by many of the ecologic effects, are out of control. If so, Christianity bears a huge burden of guilt.

Christian Anthropocentrism

Especially in its Western form, Christianity is the most anthropocentric religion the world has seen. As early as the 2nd century both Tertullian and Saint Irenaeus of Lyons were insisting that when God shaped Adam he was foreshadowing the image of the incarnate Christ, the Second Adam. Man shares, in great measure, God's transcendence of nature. Christianity, in absolute contrast to ancient paganism and Asia's religions (except, perhaps Zoroastrianism), not only established a dualism of man and nature but also insisted that it is God's will that man exploit nature for his proper ends.

At the level of the common people this worked out in an interesting way. In Antiquity every tree, every spring, every stream, every hill had its own *genius loci*, its guardian spirt. These spirits were accessible to men, but were very unlike men; centaurs, fauns, and mermaids show their ambivalence. Before one cut a tree,

*An article by this title was published in *Science*, 155, 1203 (1967), copyright 1967 by the American Association for the Advancement of Science. The present article is a reprint of only the second half of this original article. It was the subject of a Panel Discussion at the Annual Convention of the ASA, Calvin College, Grand Rapids, Michigan on August 21, 1968, and will be republished in its entirety in a collection of Dr. White's less technical essays in *Machina ex Deo: Essays in the Dynamism of Western Culture*, Massachusetts Institute of Technology Press, Cambridge. Massachusetts. Included with this reprint are the comments of three members of the Panel.

mined a mountain, or dammed a brook, it was important to placate the spirit in charge of that particular situation, and to keep it placated. By destroying pagan animism, Christianity made it possible to exploit nature in a mood of indifference to the feelings of natural objects.

It is often said that for animism the Church substituted the cult of saints. True; but the cult of saints is functionally quite different from animism. The saint is not *in* natural objects; he may have special shrines, but his citizenship is in heaven. Moreover, a saint is entirely a man; he can be approached in human terms. In addition to saints, Christianity of course also had angels and demons inherited from Judaism and perhaps, at one remove, from Zoroastrianism. But these were all as mobile as the saints themselves. The spirits *in* natural objects, which formerly had protected nature from man, evaporated. Man's effective monopoly on spirit in this world was confirmed, and the old inhibitions to the exploitation of nature crumbled.

When one speaks in such sweeping terms, a note of caution is in order. Christianity is a complex faith, and its consequences differ in differing contexts. What I have said may well apply in the medieval West where in time technology made spectacular advances. But the Greek East, a highly civilized realm of equal Christian devotion, seems to have produced no marked technological innovation after the late 7th century, when Greek fire was invented. The key to the contrast may perhaps be found in a difference in the tonality of piety and thought which students of comparative theology find between the Greek and the Latin Churches. The Greeks believed that sin was intellectual blindness, and that salvation was found in illumination, orthodoxy—that is, clear thinking. The Latins, on the other hand, felt that sin was moral evil, and that salvation was to be found in right conduct. Eastern theology has been intellectualist. Western theology has been voluntarist. The Greek saint contemplates; the Western saint acts. The implications of Christianity for the conquest of nature would emerge more easily in the Western atmosphere.

Christian Creation

The Christian dogma of creation, which is found in the first clause of all the Creeds, has another meaning for our comprehension of today's ecologic crisis. By revelation, God had given man the Bible, the Book of Scripture. But since God had made nature, nature also must reveal the divine mentality. The religious study of nature for the better understanding of God was known as natural theology. In the early Church, and always in the Greek East, nature was conceived primarily as a symbolic system through which God speaks to men: the ant is a sermon to sluggards; rising flames are the symbol of the soul's aspiration. This view of nature was

IGNORANCE, INERTIA, AND IRRESPONSIBILITY

I understand the essence of Dr. Lynn White's paper to consist of the following four main ideas:

1. Modern science is an extrapolation of Christian natural theology which realizes man's transcendency of and mastery over nature.
2. With the wedding of science and technology four generations ago man attained new powers over nature.
3. These powers are out of control and so we find ourselves in a serious ecological crisis.
4. The solution which is essentially religious involves:
   a. recognition of the guilt of Christianity;
   b. rejection of the Christian axiom that nature exists solely to serve man; and
   c. realization of a more Franciscan position which taught a spiritual autonomy of all parts of nature.

According to God's revelation it is true that man is the pinnacle of creation and that he has been given dominion over other forms of life. I agree, too, that Christianity provided a climate for development of modern science and technology. It appears to me that Christianity was necessary but probably not sufficient in itself for our great material progress. Many conditions within the Christian climate needed to be right for the Scientific and Industrial Revolutions of the seventeenth and eighteenth centuries to occur.

In many cases where there has been serious damage to the balance of nature (e.g., the loss of species or destruction of land by over cutting or unwise farming), these have occurred because man was unaware of the effects his actions would have. Many individuals, companies and nations have exercised wise control over nature, for instance, by crop rotation with fertilization, reforestation and wise stocking of species.

Causes of the Crisis

Our present ecological crisis is due to several possible causes—ignorance, inertia and irresponsibility:

1. People were, and in some cases still are, unaware that their exploitation practices would be on a large scale and in the long run detrimental.
2. As a result of former procedures, instituted at a time when a future tragedy would not have been expected, it now is too late or the inertia of the program has become so great that there appears to be little opportunity to reverse a trend.
3. Some people have acted with irresponsibility, preferring to ignore or disregard the balance of nature, the welfare of a species, and the interest of their fellow man for selfish reasons. As a result of modern technological advance, selfish men have had greater opportunity to exploit resources at the expense of others.

It seems that we will need the cooperation of science and engineering for the wise exploitation of nature, which includes the animals and plants over which God has given man dominion. Our goal should be to optimize utilization of resources so that no unutilized excess capacity remains beyond that which is required for perpetuation.

Answer to Crisis

The answer to the present crisis lies not in the abandonment of man's God-given prerogative to have dominion over nature. White suggests that man should

essentially artistic rather than scientific. While Byzantium preserved and copied great numbers of ancient Greek scientific texts, science as we conceive it could scarcely flourish in such an ambience.

However, in the Latin West by the early 13th century natural theology was following a very different bent. It was ceasing to be the decoding of the physical symbols of God's communication with man and was becoming the effort to understand God's mind by discovering how his creation operates. The rainbow was no longer simply a symbol of hope first sent to Noah after the Deluge: Robert Grosseteste, Friar Roger Bacon, and Theodoric of Freiberg produced startlingly sophisticated work on the optics of the raibow, but they did it as a venture in religious understanding. From the 18th century onward, up to and including Leibnitz and Newton, every major scientist, in effect, explained his motivations in religious terms. Indeed, if Galileo had not been so expert an amateur theologian he would have got into far less trouble: the professionals resented his intrustion. And Newton seems to have regarded himself more as a theologian than as a scientist. It was not until the late 18th century that the hypothesis of God became unnecessary to many scientists.

It is often hard for the historian to judge, when men explain why they are doing what they want to do, whether they are offering real reasons or merely culturally acceptable reasons. The consistency with with which scientists during the long formative centuries of Western science said that the task and the reward of the scientist was "to think God's thoughts after him" leads one to believe that this was their real motivation. If so, then modern Western science was cast in a matrix of Christian theology. The dynamism of religious devotion, shaped by the Judeo-Christian dogma of creation, gave it impetus.

An Alternative Christian View

We would seem to be headed toward conclusions unpalatable to many Christians. Since both *science* and *technology* are blessed words in our contemporary vocabulary, some may be happy at the notions, first, that, viewed historically, modern science is an extrapolation of natural theology and, second, that modern technology is at least partly to be explained as an Occidental, voluntarist realization of the Christian dogma of man's transcendence of, and rightful mastery over, nature. But, as we now recognize, somewhat over a century ago science and technology—hitherto quite separate activities—joined to give mankind powers which, to judge by many of the ecologic effects, are out of control. If so, Christianity bears a huge burden of guilt.

I personally doubt that disastrous ecologic backlash can be avoided simply by applying to our problems more science and more technology. Our science and technology have grown out of Christian attitudes to-

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denounce this doctrine which has provided the climate for modern advance and that man should move toward the heretical position of Francis. The human race would be unwise indeed to abandon its throne; rather it should rule nature wisely, realizing its responsibility to toil for the glory of God.

What can be done now? Firstly, effort should be made to understand the present conditions, whether due to ignorance, inertia or irresponsibility. Each situation will have its own body of data, and proper understanding will require cooperation of many people, including the scientific community. Secondly, education is essential for present and future generations regarding past history, present conditions and advisable future tactics. Thirdly, we should embark on courses leading to active programs which will result in optimal utilization of resources. Fourthly, evangelization should be stressed in order that man properly may relate to God the Creator and to His creation.

Ultimate Needs

With knowledge, active programs and education we may expect to handle pretty well all problems except the nature of man. For this we need the power of God. So evangelization is the primary responsibility of the Christian as an answer to human selfishness. The answer lies not in rejection of one Biblical teaching but rather in acceptance of entire Biblical doctrine.

Man has acted selfishly not because he wrongly believed that he was the master over the world, but rather because of his own sinful nature. Thus he has put personal interests ahead of God and of his fellow man.

What is needed is the transforming power of Jesus Christ in individual lives. This includes cleansing for sins of selfishness. Also the Bible should be accepted as God's revelation. By living with his Christian faith an individual will love God first and other men secondly. With this proper orientation toward God and His revelation man is most likely to exercise wise control over the whole of creation.

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THE SPIRITUAL VS. MATERIAL HERESY

A writer can raise questions he did not articulate consciously, and thus by writing can bring a harvest he did not anticipate. Possibly a thought something like this would go through the mind of Lynn White, Jr. if he became aware of the thought and discussion generated by his article. He did write at a time when many men of diverse backgrounds and perspectives were becoming concerned about the ecological crisis. It is fortuitous that the current annual publication of the Department of Interior is "Man . . . An Endangered Species". Possibly, Lynn White's partially confused description of the teachings of Christianity has caused more of us to think about the impact of Christian thought on the understanding of man's relationship to the natural universe. In spite of my resentment of the misrepresentation of the Christian position relating to God, man and the natural universe I do not hesitate to acknowledge my debt to Lynn White, Jr. for raising the problem not only of the crisis but also of its roots

ward man's relation to nature which are almost universally held not only by Christians and neo-Christians but also by those who fondly regard themselves as post-Christians. Respite Copernicus, all the cosmos rotates around our little globe. Despite Darwin, we are *not*, in our hearts, part of the natural process. We are superior to nature, contemptuous of it, willing to use it for our slightest whim. The present Governor of California, like myself a churchman but less troubled than I, spoke for the Christian tradition when he said (as is alleged), "when you've seen one redwood tree, you've seen them all." To a Christian a tree can be no more than a physical fact. The whole concept of the sacred grove is alien to Christianity and to the ethos of the West. For nearly 2 millennia Christian missionaries have been chopping down sacred groves, which are idolatrous because they assume spirit in nature.

Man-Nature Relationship

What we do about ecology depends on our ideas of the man-nature relationship. More science and more technology are not going to get us out of the present ecologic crisis until we find a new religion, or rethink our old one. The beatniks, who are the basic revolutionaries of our time, show a sound instinct in their affinity for Zen Buddhism, which conceives of the man-nature relationship as very nearly the mirror image of the Christian view. Zen, however, is as deeply conditioned by Asian history as Christianity is by the experience of the West, and I am dubious of its viability among us.

Saint Francis of Assisi

Possibly we should ponder the greatest radical in Christian history since Christ: Saint Francis of Assisi. The prime miracle of Saint Francis is the fact that he did not end at the stake, as many of his left-wing followers did. He was so clearly heretical that a General of the Franciscan Order, Saint Bonaventura, a great and perceptive Christian, tried to suppress the early accounts of Franciscanism. The key to an understanding of Francis is his belief in the virtue of humility—not merely for the individual but for man as a species. Francis tried to depose man from his monarchy over creation and set up a democracy of all God's creatures. With him the ant is no longer simply a homily for the lazy, flames a sign of the thrust of the soul toward union with God; now they are Brother Ant and Sister Fire, praising the Creator in their own ways as Brother Man does in his.

Later commentators have said that Francis preached to the birds as a rebuke to men who would not listen. The records do not read so: he urged the little birds to praise God, and in spiritual ecstasy they flapped

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and also for reminding us of the importance of the life of St. Francis. Indirectly, he has reminded us that the most crucial aspect of the historical root is theological.

False Notions of Christianity

One unfortunate aspect of Lynn White's article is that it may spread or reinforce some of the false notions about Christianity and the supposed irrelevance or even harmfulness of the church in the world today.

All the article's erroneous statements seem to stem from White's main heretical concept that there is a "Christian axiom that nature has no reason for existence save to serve man". Such a statement could result from a study of the behavior of "Christianized" peoples, but I would rather have White point to the disparity between behavior and the Biblical truth which should form the basis for the behavior of man. More helpful would be a reminder for all men that Christianity has something positive and constructive to say about the relationship of God, man and nature and that the gospel has implications of good news for nature as well as for man.

Why has Christianity communicated such confused testimony to the world and to itself? I suspect that the basis is in one of our heresies that has separated "spiritual" from "material" with the resultant error that only the soul of man has value in the eyes of God and, therefore, we should have concern for the salvation of souls with little or no concern for the body. The corollary is that if the body of man is of little or no concern the natural universe deserves even less concern. This heresy in its many subtle forms has done and is doing great harm to the church of Jesus Christ by misleading many who are in the church and confusing and repelling many who are outside. It is an unbalanced or incomplete gospel. One would gain the impression that the Cultural Mandate was cancelled at the Fall and that the implications of the good news of redemption in Christ was limited to man alone.

The Cultural Mandate

I could wish that our theologians had probed the breadth and depth of what the Bible teaches about the relation of God, man and natural universe; not only the universe "out there" but the natural environment in which we live, the animate and inanimate stuff around us. However, time has run out and we must move forward on the basis of Biblical concepts to guide thought and action concerning the natural universe. I believe that the Cultural Mandate which places responsibility for care of the universe squarely on man continues in force until the end of time. The Fall perverted man's view not only of himself and his neighbor but also of nature. In seeking to serve self above all, man "uses" not only other people but also misuses nature.

In Jesus Christ God established redemption of man in soul and body. What can we say about the redemption of the natural universe that fell with man? We can say that redeemed man should be the natural caretaker of a universe given hope by the Redeemer. Paul seems to say that nature must groan and travail until the end of time even though we know that all things have been renewed in Christ. In a sense, man also must groan and travail as he works out, in fear and trembling as well as in joy and expectation the salvation given him. It is clear that this salvation cannot be a self centered thing. It must be a new creative relationship with God and man conditioned by the love of God.

What can we say about a natural universe created and affirmed by God to be good? Just as man is appointed coworker with Christ in reconciling the world of people for God so man must redeem the universe for God. Man is not saved for himself but is saved by God for others and for the universe. Man may not as-

their wings and chirped rejoicing. Legends of saints, especially the Irish saints, had long told of their dealings with animals but always, I believe, to show their human dominance over creatures. With Francis it is different. The land around Gubbio in the Apennines was being ravaged by a fierce wolf. Saint Francis, says the legend, talked to the wolf and persuaded him of the error of his ways. The wolf repented, died in the odor of sanctity, and was buried in consecrated ground.

What Sir Steven Ruciman calls "the Franciscan doctrine of the animal soul" was quickly stamped out. Quite possibly it was in part inspired, consciously or unconsciously, by the belief in reincarnation held by the Cathar heretics who at that time teemed in Italy and southern France, and who presumably had got it originally from India. It is significant that at just the same moment, about 1200, traces of metempsychosis are found also in western Judaism, in the Provencal *Cabbala*. But Francis held neither to transmigration of souls nor to pantheism. His view of nature and of man rested on a unique sort of pan-psychism of all things animate and inanimate, designed for the glorification of their transcendent Creator, who, in the ultimate gesture of cosmic humility, assumed flesh, lay helpless in a manger, and hung dying on a scaffold.

I am not suggesting that many contemporary Americans who are concerned about our ecologic crisis will be either able or willing to counsel with wolves or exhort birds. However, the present increasing disruption of the global environment is the product of a dynamic technology and science which were originating in the Western medieval world against which Saint Francis was rebelling in so original a way. Their growth cannot be understood historically apart from distinctive attitudes toward nature which are deeply grounded in Christian dogma. The fact that most people do not think of these attitudes as Christian is irrelevant. No new set of basic values has been accepted in our society to displace those of Christianity. Hence we shall continue to have a worsening ecologic crisis until we reject the Christian axiom that nature has no reason for existence save to serve man.

The greatest spiritual revolutionary in Western history, Saint Francis, proposed what he thought was an alternative Christian view of nature and man's relation to it: he tried to substitute the idea of the equality of all creatures, including man, for the idea of man's limitless rule of creation. He failed. Both our present science and our present technology are so tinctured with orthodox Christian arrogance toward nature that no solution for our ecologic crisis can be expected from them alone. Since the roots of our trouble are so largely religious, the remedy must also be essentially religious, whether we call it that or not. We must rethink and refeel our nature and destiny. The profoundly religious, but heretical, sense of the primitive Franciscans for the spiritual autonomy of all parts of nature may point a direction. I propose Francis as a patron saint for ecologists.

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sume an attitude toward nature other than that shown by God any more than he may assume an attitude toward persons not shown by God. Can we doubt that God loves His natural universe that He called "very good"?

Lynn White's challenge stays with us in his words, "Our ecologic crisis is the product of an emerging, entirely novel, democratic culture. The issue is whether a democratized world can survive its own implications. Presumably we cannot unless we rethink our axioms." Let us respond with appropriate thought and action.

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INDIFFERENCE TO EXPLOITATION UNJUSTIFIABLE

With the advent of freer discussion in our society, the orthodox Christian church can expect to be publicly blamed for some of the ills of society. Dr. White's article concerns the effect of so-called Christian teachings on our attitude toward nature and the use of nature. There is nothing wrong with an airing of these views and such discussion may actually result in positive thinking by evangelical Christians. It is necessary, however, that the blame ascribed be carefully examined and rightly placed.

Human Nature

Dr. White seems to feel that Christian doctrine has made the average Christian a self-centered individual when it comes to nature's provisions and that the Christian thinks that since he has dominion over something this releases him to exploit it according to his own will. Indeed, the nature of man is such that we must enact strict laws to keep what natural resources we do have. When free to do so, most men will take whatever they can get and often call themselves Christian while doing it. Are these men influenced to do this because of Biblical teaching, a culturally inspired form of Christianity, or for some other reason? Does this action stem from their world and life view or emanate from a source inherent within the man? Does a Christian really have dominion in the sense of exploitation?

A Non-Christian Trap

It is true that Christianity did attempt to destroy the idea of animism (or in a sense pantheism) and thus released man from his superstitious fear of nature. This allowed what we now consider to be progress to take place so one would have to blame Christianity for this progress as well as the "destruction" of nature. The early settlers arriving on the shores of America soon after its discovery were faced with so many resources that the end was not in sight. There was little tension between people for possessing things because there was so much for all. Nature was to be warred against. A man was to work hard to reap what he could and the lazy man was not "Christian". The workers trapped, dug, and cut. This fit in well with man's nature and the drive to better himself. Somewhere along the line there no longer was an abundance of natural resources for all, but the nature of man and his basic drives remained

Buffalo once roamed the United States from Cape Cod to California. During the Civil War a herd of four million covered one 50-mile area in Kansas. By 1830 they had all disappeared from east of the Mississippi. In a 30-year period, herds of thirty million buffalo were reduced to zero. Some sixty million beaver were exterminated. Passenger pigeons whose flight darkened the sky with their millions were slain in such numbers that none were left after the last one died in a Cincinnati zoo in 1914. Now on their way to extinction unless they can be saved in our national wildlife refuges are the timber wolf, grizzly bear, nene goose, larger whales, whooping cranes, Everglade kite, California condor, puma, alligator, and musk ox. The story of how mankind in the new world, for greed or to subdue nature, managed to accomplish the above in a period of less than 200 years, is not a pleasant one. Cognizant of past mistakes, enlightened and dedicated people are trying to correct them now in areas where it is still not too late.

Luella K. Sawyer
In book review of **Wild Sanctuaries,** by Robert Murphy, Dutton, N.Y. (1968)
Sierra Club Bulletin, December 1968, p. 14

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the same. It became culturally acceptable for the Christian to continue in this way and the minister never told him otherwise. It was a trap that was not really Christian.

There is no way that an evangelical Christian can biblically justify an indifference to the exploitation of nature. True Christianity is supposed to free a man from his natural self-centeredness and turn his mind toward the welfare of others. The Christian should not be interested in the exploitation of the here and now. Having dominion over or control of something, should mean its protection rather than the improper use of it. Therefore, those who think that Christianity is a cover for the self-centered use of any part of nature, be it another man, a forest or a stream, need to rethink their position to see whether this attitude stems from God's nature or their own. Furthermore, since we believe that God acted in the creation of nature, we should be expected to be the proper keepers of the vineyard. The motivation for properly protecting something that was a gift from our Lord and Savior should be far higher than that of a man who believes that it all happened by accident with no intervention by God.

Understanding and Action

Some, such as White, suggest that we need to rethink our religion and allow it to evolve to a more tenable position about nature. I would say that we need a proper understanding of the basic tenets of our faith and a willingness to abide by them. An improper use of our resources does not fit in with the nature of God as revealed in the total picture of the Bible. We need to rake from our minds the culturally inspired tenets that do not really express the essence of Christianity and scrape off the veneers from our own self-interests to expose them for what they really are. We need to correct the erroneous ideas about nature that we have allowed onlookers to gather from us after we have shed them ourselves.

How can we begin to do some of these things? Our evangelical ministers should start reminding the believers that we need God's power to overcome our bent toward using nature selfishly. Some courses designed to make the students in our evangelical colleges and seminaries more aware of the problems facing man as he lives with nature would be helpful in this matter. Church groups ought to be willing to discuss what part they might have in protecting their immediate part of the world from those who would misuse it. This can be done without neglecting the main thrust of the church in winning the lost. In fact, it may help the latter thrust. The liberal Protestant churches are now spending time discussing these matters to try to make a man act good in his own right, but without God's power in his life that man soon reverts back to his true nature. The changed nature that God gives us is our asset. Evangelical Christians can join and be active in one of their local conservation groups out of a heartfelt desire to watch over God's universe rather than just being a good citizen or joining because all the "right" people are members. Since we share the guilt of improper attitudes toward our surroundings, do we not need to help set the record straight? Perhaps we have made some start in the ASA.

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Chromosomes and Human Behavior*

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An adequate technique for studying human chromosomes was first reported in 1956. *Three years later the presence of an extra chromosome (trisomy) was discovered in cases of Down's syndrome (mongolism). Since then human cytogenetics has developed into an important research and clinical tool.*[1]

EFFECTS AND INCIDENCE

Some of the chromosomal aberrations result in severe congenital malformations, mental retardation, and reduced life span. Variations in the number of sex chromosomes may cause infertility, specific malformations, and some intellectual impairment. At least one per cent of newborn children have an abnormal chromosome constitution of some type.[2] The incidence of certain abnormal sex chromosome patterns is approximately as follows:

XO (Turner's syndrome)	2-3 per 10,000 newborn females
XXY (Klinefelter's syndrome)	20 per 10,000 newborn males
XXYY	1 per 10,000 newborn males
XYY	3-5 per 10,000 newborn males

The first case of an XYY pattern was reported in 1962, and a dozen more were added in the next three years. Meanwhile studies of selected populations were carried out. Casey *et al.*[3] found 21 out of 942 men in two English special hospitals for dangerous, violent, or criminal patients of subnormal intelligence to be chromatin-positive (having two X chromosomes). Of these 7 had an XXYY pattern. The unusually high frequency of two Ys suggested a possible relationship with the reason for institutionalization.

Following this lead, Jacobs *et al.*[4] studied 342 men in a similar hospital in Scotland, and found 16 with chromosome anomalies (9 with XYY, one XXY, one XXYY, one mosaic XY/XXY/XXXY, and four with problems involving other chromosomes). For the ten men with two Y chromosomes the mean height was 72 inches, as compared with a mean of 67 inches for other men tested. Of the nine XYY males, seven were considered to be subnormal in IQ. Eight were cooperative in the test situation, while one was sullen, solitary, and suspicious. There was no history of excessive alcoholism. They gave the general impression of lack of emotion, casualness, and absence of guilt. The most common crimes were theft and housebreaking.

In the same XYY subjects Price and Whatmore[5] reported no physical abnormality or problem in sex development. The mean age at first conviction was 13 years as compared with 19 years for controls. There appeared to be a limited capacity for affection and an inability to establish normal interpersonal relationships. A more detailed psychological study of 7 of these subjects and 11 matched controls was reported by Hope *et al.* [6]

Telfer *et al.*[7] studied those inmates of four criminal institutions in Pennsylvania who were 71 inches or more in height (a total of 129) and found seven XXY and five XYY. In a Melbourne prison among 34 men 69 inches or taller Wiener *et al.*[8] found three XYY and one XYY/XYYY. Thus an unusually high prevalence of a YY pattern has been found in several independent samples of tall men in criminal institutions.

IMPORTANT QUESTIONS

Some important questions must be answered by further research:

1) How common is an XYY pattern among males in the general population? The estimate of 3-5 per 10,000 given above is only a first approximation. It is possible (but not yet certain) that there are many XYY males who are essentially normal in behavior.

2) Assuming that variability in physical features and behavior will be observed, what biochemical or anatomical differences are there between those XYY males who show tendencies toward criminal, anti-social, or aggressive behavior and those who are essentially normal?

3) If a significant proportion of XYY males show behavior problems, what modes of therapy (biochemical or psychological) will aid in ameliorating or preventing the difficulties?

4) Here is an opportunity to define more clearly what is meant by aggressive or antisocial behavior. Social scientists who specialize in such problems can

*Presented at the Convention of the American Scientific Affiliation at Calvin College, Grand Rapids, Michigan on August 20, 1968.

make a significant contribution to their own fields and to human genetics.

BASIC PROBLEMS

These findings also pose some interesting problems for pastors, teachers, and parents:

1) If an XYY effect upon behavior is established, this is only one addition to a growing list of specific genetic conditions affecting human behavior. The Lesch-Nyhan[9] syndrome is another recently identified trait, involving mental retardation and a bizarre form of self-mutilation. It is no longer possible (if it ever was) to view the "mind" as isolated from the "body."

2) Does this mean that a person is not responsible for his actions? It is difficult to answer this question directly. Society has already accepted the idea that under certain conditions (such as "insanity") an individual cannot be held responsible. The XYY condition would appear to be only one specified extension of this principle.

3) If a baby boy is found to have an XYY chromosome pattern, what should his parents be told? In view of the recent reports in popular magazines on the XYY male, this information may be more threatening to his parents than a diagnosis of severe mental retardation. When more detailed information becomes available about the differences between those with disturbed and with normal behavior, some more precise tests may permit more accurate predictions. Meanwhile, the physician in some cases may decide to withhold the information, merely stressing the need for frequent check-ups.

4) In other genetic conditions we are finding that some affected individuals develop well without treatment. On this basis, it is reasonable to insist that prognosis, therapy, and education for an XYY male should *never* be based only on chromosome studies. Other types of individualized assessment are always essential.

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The biblical and theological use of the idea of creation clearly shows that the idea is primarily of religious origins and meanings. It has not in the first instance arisen, nor has it functioned, as an answer to a scientific question, or to a metaphysical question, about the nature of our universe. Rather, what it has conveyed to those who affirmed it was an answer to the religious question about the meaning and purpose of our finite life. And it has conveyed this meaning by pointing to the glory and power of God who created the heavens and the earth, and the dependence, the goodness, and the responsibility of His creature man, set within a nature and a history that lie under God's sovereign will. It is an idea that has been derived not from a careful scientific or metaphysical analysis of the general experience of nature and of finite existence, but rather from the illumination that comes from special encounters with God in revelatory experiences. . . . .

The uniqueness and transcendence of the divine creative act also explains in further detail why this event can never be an object of scientific inquiry. The purpose of science is to trace and to understand the invariable relations between finite events within the experienced system of the world. It assumes that each event it investigates "comes to be" out of already existing finite events of the same order, and it tries to uncover their significant relations; it also assumes that every event it is concerned with is similar in basic structure to events that can be reproduced and studied here and now. Thus any scientific inquiry presupposes the existence of finite process and conducts its inquiries solely within the scope of that process. Science can therefore inform us about the character and development of the world that God has created, but it cannot and does not seek to study the event by which the whole process came into being. Because they have reference to events on two entirely different levels of being, the inquiries of science and the theological doctrine of creation cannot conflict.

Some Personal Reflections on 1968

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It is coming to be expected *that each year will be more exciting than the preceding one but try to sell that story to anyone who was middle-aged in* 1929. *Seriously there is much to remember about last year, some with pleasure and much of it with regret.*

Biology and Cytology

In biology a drug named L-dopa showed great promise in 1968 in the treatment of Parkinson's disease. It must be reported, however, that not all cases responded to the drug. An interesting development concerned cytology. Some people have an extra chromosome in their cells, forty-seven instead of forty-six, the XYY complex. A study showed that persons with this cytological picture may show a higher tendency toward delinquency or criminality (although not all do). A startling aspect here is that while most legal experts are not inclined to exonerate a person because of their cytology, a court in Australia did just this thing in the case of an XYY person, allowing a killer to plead insanity.

Diabetes

Diabetes took another blow in 1968 when German researchers synthesized glucagon, a sugar-mobilizing hormone of the pancreas.

Lunar Travel

A not-too-surprising result of the lunar orbiting mission was confirmation of the unsuitability of the moon as a future home for man, at least outside of a capsule. Man will always be tied to the ecology of the earth, or a *reasonable* facsimile of our mother globe.

Organ Transplants

Transplantations of human organs such as livers, lungs, pancreas, intestines and hearts accelerated greatly. Although the first heart transplant patient (in 1967) died, the first 1968 patient is still living after a year. Much is being written now about moral and legal aspects of transplants and one is asked the age-old questions again—when is a man dead?—if you remove a heart from a dying person, are you committing murder? Then there is the new question—who is going to play God in assigning priority for the few available organs? Are all men equal and does a rich playboy have as much "right" to a heart as a rich humanitarian? A good deal of soul searching is being done by Christians on these questions despite the more or less agreement among experts that a certificate of "brain death" will be the guideline before a heart can be removed. The act of saving a dying person's life by removing an organ from a person already dead, is in the last analysis, an act of conservation.

Conservation and the Leopard

Speaking of conservation, the Duke of Edinburgh persuaded the Queen to stop wearing her leopard coat in an effort to stop the senseless slaughter of these beautiful animals. We hope this strategem works and, at the same time, we shed a tear for the whales, the tapirs, the polar bears and all of the other defenseless creatures now in danger of extinction.

Spaceship Earth

There has been a growing awareness in 1968 that the earth is a rather small spaceship and that its resources are definitely limited. Its water, soil and air can actually be so befouled by man himself that life can *actually* become impossible here. There is, too, a glimmer of hopelessness in making forward progress in the face of a forthcoming *crush* of unnecessary humanity. Shall the world improve or will overpopulation stifle progress? Despite heroic efforts, pills and intrauterine devices are not reaching enough women in the childbearing age.

Loser of the Year

There were many winners last year and it would be very difficult to select the top one. There is no difficulty in picking *the* loser of the year. I refer to Pope Paul VI. At the 1968 meetings in Dallas of the AAAS, 2,600 scientists said the Pope (by his ban on artificial contraception) "has sanctioned the deaths of countless numbers of human beings with his misguided and immoral encyclical". It is a well-known fact that about 50% of all Roman Catholics have used contraception in the past. It is my hope that, as a result of the ban, this number will quickly reach 100 per cent.

March Fourth Convocation: Science and Society

A voluntary day-long stopping of research activities by faculty and students was observed on March 4 at over 50 universities across the nation. The purpose of the research shutdown was to afford the opportunity for careful examination of the growing social and political concerns of scientists, particularly in connection with the complexities of military vs. humanitarian involvements. This article is a report on the March Fourth Convocation at Stanford University.

Opening Presentations

P. Grobstein, a graduate student in biology, summarized the chief concerns of the convocation: (1) that science and technology are losing relevance to the real needs of the world, and (2) that we do not have the means to control the future of science and technology. Questions raised included: What is the responsibility of the scientist in society? Is the scientific community functioning as a vital part of society? Have scientists lived up to the responsibility that is inescapably theirs because of the power that their knowledge gives them? Should we think of science as morally neutral, only a useful technique? He pled for a free and open investigation of all problems, the emphasis that a rational search for truth is still a viable approach.

Dr. J. Lederberg, Professor of Genetics and Nobel Laureate, called nationalism one of the principle diseases of the human condition. It might be easier to modify man through affecting his innate biology than to modify him through reforming his social institutions. Science was presented as being almost the most subversive (i.e., non-nationalistic) enterprise carried on in the world today. (*It is curious that the Christian Church did not suggest itself in this connection.*) In place of our passive acceptance of present discriminatory practices before birth—which we call global malnutrition—Dr. Lederberg presented the need to set up a rational human biological policy. The question needs to be faced: is life itself and its indefinite elongation *the* system value to be pursued by such a policy? Should a decision be made evaluating a long miserable life with respect to a shorter happy one? Technical possibilities now on the biological horizon calling for policy attention are: (1) pre-natal detection of birth defects in infants with subsequent authorized abortion; (2) augmenting the genetic blueprints of individuals in the way that we are currently protected against certain viruses by innoculation; and (3) the development of asexual reproduction, with at least the possibility of attempting to solve the relative influence on the individual of genetic vs. environmental effects.

Dr. L. I. Schiff, Professor of Physics, defended the importance of basic scientific research as valuable to all of society and deserving of support from all branches of society. He argued that to use present or potential applicability as a criterion to judge the merit of basic science is to deprive it of its basic genius.

Dr. S. Drell, Professor of Physics, a member of Stanford's Linear Accelerator Center, and Presidential Science Advisor, summarized both the positive and the negative contributions of modern technology. He addressed himself to the question, What role can a scientist play in government? Frequently quoting Einstein, "Politics is much harder than science," he emphasized that a scientist decides what is, but a politician must decide what ought to be, and then must decide what can be done. Scientists speaking to the question of what ought to be speak with no special authority compared to any other citizen of the country; scientists speaking to the question of what is and what can be done are exercising their particular expertise. He discussed the complex technical considerations involved in the anti-ballistic missile program and indicated that sound technical inputs often make it much more difficult to come to a decision.

Dr. J. Linvill, Professor of Electrical Engineering, emphasized the many ways in which the engineer is busy working for a better society. Specific examples drawn from the program at Stanford include a reading aid for the blind, electronic instrumentation for medical research including a computor program for analysis of electrocardiograms, and the utilization of satellite communication for education in undeveloped countries.

Appropriately the opening and closing sessions of the Convocation were held in Memorial Church.

Panel Discussions

Following the opening addresses were a series of seven workshop panel discussions on the topics: technology and social development, military-industrial-university complex, biology and its implications, basic science: who should support it?, chemical-biological warfare, anti-ballistic missile, and population and pollution. Underlying some of the reaction to the technical discussions was the feeling that the technical details were only one small feature of the total picture, that somehow one had to learn how to feed moral and ethical values into the total decision-making equation.

Another point frequently emphasized was that the responsibility for undertaking a specific research project is that of the individual faculty member in the university, who contracts for each project independently. The responsibility of the individual research worker is to refuse to work on directed research in an area he considers in good conscience to be immoral.

Scientists, Engineers, and Politics

This was the title of the closing address by Dr. M. Perl, Professor associated with the Stanford Linear

Accelerator. He emphasized that political reality, like physical reality, had to be lived and dealt with. The recognition of political reality meant the recognition of five points: (1) self-interest groups exist, (2) individuals' ideas will be intransigent because the organization to which they belong profits by a particular approach, (3) decisions in the legislature are not based on a simple rational approach, (4) the public is in despair about understanding technology, and (5) the scientific establishment tends not to rock the boat. He called scientists to become involved as scientific advisors to government, by contributing to the general public information both individually and through concerned societies such as the Federation of American Scientists and the American Society for Responsibility in Science, and by helping to put science and technology back into grass-root politics. Facing the realities of political life calls for the acquisition of political power to combat self-interest groups by lining up our own self-interest motivated allies; insisting on open professional and public debate on such urgent issues as pollution, environmental problems and the weapons program; being prepared to make suitable "deals" to achieve desired goals; voluntary offering of service by scientists as professional advisors to the Congress; and last of all—luck.

Reflections

Yes, "Politics *is* much harder than science." It is certainly harder than science—and coffee-klatsch evangelism. What is the responsibility of the man who is not only a scientist—but is also a Christian? It is timely that the theme of the 1969 Annual ASA Convention (Gordon College, Massachusetts, August 19-22) is *Science, Scripture, and Social Issues.*

Editor's Note: It is important that we as Christian men of science keep aware of the dominant patterns of thought in science as it is practiced in many different cultural and philosophical environments. Quotes such as the following from *Soviet Life* should be interpreted as an attempt to fulfill this need.

Historical science will become more scientific when it comes to understand more fully and precisely the laws governing the action of the masses in history including the law of the "revolt of the masses" that has been the pivot point of all history and that sociologists like Ortega y Gasset damn. History will also become more of a science to the degree that it can rise above the boundaries that divide mankind into parts opposing one another. In this search there are many unknown difficulties and undiscovered laws. But historical science will in the end become a genuine science about the masses and a genuine science about mankind..... Our future, communism, is not a quiet harbor, as many once naively thought, but a way of achieving an absolute acceleration of development. Communism is not a stopping place but a dynamic concept. It signifies the first possibility we have achieved of moving and growing with increasing speed without social obstacles or obstructions. All of human history, looked at from the viewpoint of speed, has developed along an exponential curve, in geometric progression. The past few centuries have been marked by a sharp acceleration of development. This has brought mankind up to communism, the part of the curve where acceleration will not be hampered in any way and will continuously increase. If we approach forecasts in social psychology from this standpoint, we know for certain that the swiftness of historical dynamics will make new demands on the psyche.

Professor **Boris Porshnev**, Doctor of Science (History)
From **Soviet Life**, December 1968, p. 57

BOOK REVIEWS

SCIENCE, SECULARIZATION AND GOD by Kenneth Cauthen. Nashville: Abingdon Press, 1969. 237 pp.

This book is a welcome contribution to academic pursuits in that it aims to speak to man's contemporary situation from a biblical perspective and from an appreciation of natural theology and metaphysical philosophy. Cauthen is trying "to investigate the relationship of a biblically grounded religion to the science-dominated, secularized culture of our time in pursuit of the thesis that is possible to be both a serious Christian and intelligent modern."(p.14). A valid review will evaluate how well he has accomplished his task.

The book reveals a sensitive, agonizing mind which is trying to find grounds for purpose in the structure of the universe and from within biblical revelation. Having rejected revivalistic pietism, classical Protestant supernaturalism, ontological metaphysical Greek philosophical systematizing, and transcendent neo-orthodoxy, Cauthen reaches out from a naturalistic theism in terms of process philosophy and its idea of becoming. The scientific revolution has questioned Christianity's credibility; the process of secularization is questioning its relevance; historical criticism questions its essence. The author wishes to present Christianity as a moral, but not a necessary, option for modern man. There is a transparent honesty in his gropings, a precise and penetrating analysis of the current theological and philosophical situation, and an appreciation of the necessity of presuppositional methods of argumentation. Cauthen is calling for dialogue.

Dialogue for this reviewer is difficult at this point, for Cauthen too easily dismisses the classical Protestant orthodoxy from within which the reviewer speaks. The important problems to which Cauthen speaks have been treated by contemporary (and older) orthodox theologians. In terms of evolution, Cauthen argues for purpose from the life principle within reality which pushes ever forward. He fails to mention that older evangelicals, such as A.H. Strong and J. Orr recognized that evolution may be describing how God works and does not exclude "involution" in terms of creation *ex nihilo,* evolution in terms of progress, and "devolution" in terms of decay due to the primal fall. The late evangelical E. J. Carnell spoke of "threshold evolution."

Cauthen's view of revelation is not the unveiling of a word in deed and proposition from a transcendent God, but the God who is contained within and suffers with his universe, striving for perfection. The older fundamentalism certainly veered away from immanence, deed revelation, and an appreciation of general revelation of natural theology, but contemporary evangelicals are wrestling with the relationship between propositional revelation and other modes of divine disclosure (B. Ramm, C. F. H. Henry, J. I. Packer). Cauthen, of course, categorically dismisses the infallibility of both Scripture and the papacy. This brings us to, perhaps, the major flaw in his book.

It is Cauthen's inability to rescue himself from the older classical liberalism in terms of the proper and rational use of language that is most perplexing. His love for biblical language is clear; his use of it is puzzling. He continually speaks of "the symbolic meaning of the cross and resurrection of Jesus of Nazareth" (pp. 9, 129, 137, 140, 141, 145, *et als*). He does not mean by this the intention of the biblical writer to describe the miraculous, bodily resurrection of Jesus from the tomb. Rather Cauthen is trying to describe his concept of a finite, struggling god in these classical terms. Can meaningful dialogue take place within this context? The creation of the universe is also spoken of in terms of "symbol." Can a valid concept of natural theology or general revelation be erected upon such a use of the biblical language?

In the end, Cauthen's view is a reinterpretation of classical liberalism, for he drives a wedge between the Christ of faith and the Jesus of history, describes the essence of Christianity as the great love commandment, and denies that the meaning of the cross and resurrection rests upon an event in the objective, historical world. The preaching of neo-orthodoxy is returning to the exhortation of liberalism. God is becoming man, and man is pushing beyond his present state to higher levels: he is becoming God.

It is one thing to sit back and criticize efforts to be Christian, relevant, and credible. It is another thing to speak creatively from a biblical, orthodox, evangelical viewpoint to man in his current agony. If the truth lies within evangelicalism, Cauthen challenges us to produce something better.

Reviewed by Irwin Reist, Associate Professor of Bible and Theology, Houghton College, Houghton, New York.

THE DIALOGUE BETWEEN THEOLOGY AND PSYCHOLOGY edited by Peter Homans. University of Chicago, 1968. 295 pp. $7.95.

Can psychodynamic theory as elaborated by the personality sciences help to clarify the nature of faith? This symposium, originating in the 1966 centennial conference at the University of Chicago Divinity School, offers an answer. Most of the eleven authors studied with Seward Hiltner, to whom the volume is dedicated. As the introduction forecasts, the contributors all reflect in some degree the Chicago school's position on the psychology of religion and theological liberalism.

The tone of the symposium is set in the editor's essay, "Toward a Psychology of Religion: Via Freud and Tillich." Homans notes the demise of the tradi-

tional psychology of religion, attributing its decline to the rise of psychoanalysis and Watsonian behaviorism, which removed the conversion experience from the domain of psychology. At the same time, theology rejected religious experience in favor of an existential approach. The resultant splitting of the psychology of religion into theology and psychology produced the pastoral-psychology movement, which is deeply committed to a psychoanalytic orientation. Pastoral psychology has substituted psychotherapy for the conversion experience. Still an applied discipline, it lacks adequate theological integration, recalling the similar plight of the religious-education movement.

Homans proposes to transcend the traditional view of theological anthropology, that there is a realm of reality beyond the processes open to psychological categories and methods. Seeking to formulate a dynamic psychology of the self that will include the subject matter of theology, he points to the propriate striving of Allport, the self-actualization of Maslow, the fully functioning person of Carl Rogers, and the identity formation of Erikson, as lying within the proper territory of theology. He finds in the use of the superego concept by both Freud and Tillich a common element that he believes is amenable both to psychological analysis and religious interpretation.

The dynamic root of sin in the human personality is the subject of an essay by Fred Berthold, who believes that Protestant discussions of sin have refused to face the question of why man turns pridefully away from God. He finds an answer in the psychoanalytic concept of narcissism, which is traced to the "primal anxiety" of the nursing period. The child responds to his awareness of helplessness and maternal dependency with anxiety and aggression, and seeks to turn away from the mother in independence and mastery. The feelings of guilt and unworthiness that follow evoke inordinate self-love to compensate. The basic sin of narcissism is therefore a response to one's feeling of smallness and unworthiness. Berthold does not clarify the source of the child's aggression.

For several of the essayists, Erik Erikson's concept of ego-identity becomes the medium of synthesis between theology and psychology. Psychotherapy concerns itself with insight into identity, and theology concerns itself with revelation. Since both processes lead to transfiguring knowledge, concludes Charles Stinnette, they represent not human achievement and divine gift but one process of knowing. "Christ enters man's biographical history as the ultimate answer to man's quest for identity and meaning." For Leland Elhard, faith and identity coincide. "Both point to the self-in-God, where one is fully God's self and fully one's own self at the same time."

The chapter by Leroy Aden on pastoral counseling stands out because of its simple thesis and its lack of ambiguity. Pastoral psychology has been more concerned with a psychological than with a theological perspective. A psychological framework such as the Freudian or the Rogerian has displaced the counselor's own faith. Since Christian faith is the dominant concern in the pastor's profession, it should be the distinctive mark of pastoral counseling. The client's basic struggle is with finitude, alienation, and guilt. These must be met "in the light of the revelation which is disclosed and embodied in Jesus Christ."

The essayists make a strenuous effort to bring theology and psychology into some kind of synthesis. They succeed in placing the two disciplines near each other and throwing across a bridge built by myth, symbol, and elements of personality theory. But the bridge is hardly solid enough for traffic and is not likely to satisfy either side. Indeed, no synthesis is likely to succeed so long as psychology insists upon being rigidly empirical and so long as the Cross remains a scandal.

Reviewed by Orville S. Walters. Professor of Health Science and Lecturer in Psychiatry, University of Illinois, Urbana, Illinois.

ESCAPE FROM REASON and **THE GOD WHO IS THERE** by Francis A. Schaeffer. Intervarsity Press, Chicago 1968. 96 pp. 95 cents, and 191 pp. $2.50, respectively.

In these two books, Dr. Francis A. Schaeffer, noted Christian apologist and director of the L'Abri Fellowship in Switzerland, relentlessly pursues the development of modern thought to its inevitable conclusions in belief and practice. He argues that a change in thinking has occurred in every branch of thought, starting with philosophy and proceeding inexorably through art, music, and general culture, finally to theology itself. This change in thinking is crucial. It deals with the way we come to knowledge and truth, and its effects are responsible for the widening generation gap of our day.

Before this change occurred, man thought of knowledge in terms of antithesis, i.e., if something is A, it is not not-A. Truth had meaning; something that was not true was false. Starting with Hegel, however, Schaeffer argues that a subtle but revolutionary change has occurred in man's attitude toward truth. Realizing the impossibility of arriving at a unified picture of all of reality on the basis of man-centered rationalism and scientific methodology, thinkers have relativized truth so that a sharp distinction between truth and falsehood no longer exists. Instead of antithesis, synthesis is offered as the guide to progress; given a point of view and its opposite, progress is made by seeking a synthesis between these two apparently conflicting views.

Such a change in thinking represents a surrender of the attempt to develop a unified picture of life that will embrace both the rational aspects of life and the spiritual, grace-related, or freedom-related aspects of life. By setting up a complete barrier between these two spheres of reality, modern man has made it impossible to make the step from rationality to meaning. Realizing intuitively, however, that the impersonal models of himself as a machine that he has developed from rationalism can never stand the test of actual life experience, he has been forced into either complete despair, or into an irrational "leap of faith" that attempts to claim contact in the realm of faith and the spirit, which he has no reason to believe even exists. Such a claimed contact has no basis except experience, cannot be communicated, and ultimately

leads to the various modern manifestations of mysticism seen in "chance" art, drugs, pornography, and illusion-oriented drama.

As a contrast to this pattern of seeking to establish spiritual reality by an irrational leap of faith, Dr. Schaeffer presents historic Christianity as a perspective on life that makes possible a unified view of all of reality that can be based upon a rational faith. Rooted in the historic events of the life of the people of Israel, in the life, death, and resurrection of Jesus Christ, Christianity offers the kind of basic answers to the needs of man that can be found in no other way. Dr. Schaeffer urges an approach to evangelism that recognizes that each man without Christ stands stranded somewhere between his intuitive apprehension of the external world and himself, and the results of his non-Christian presuppositions. The task of the evangelist is to drive home to this man the bankruptcy of his non-Christian presuppositions and then to apply the Gospel of Biblical Christianity.

This is all pretty powerful stuff, and well worth integrating into one's overall perspective on the interaction of Christian faith with life.

Reviewed by Richard H. Bube, Department of Materials Science, Stanford University, Stanford, California.

A second review of ***The God Who is There . . . .***

In my office hangs a little motto someone once gave me: "I know that you believe you understand what you think I said, but I am not sure that you realize that what you heard is not what I meant." This summarizes a major problem in communicating with others and it reminds me not to take communication with my colleagues for granted. Dr. Francis Schaeffer, in his book, "The God Who is There", also is concerned about the problem of communicating. His subtitle, "Speaking Historical Christianity into the Twentieth Century" is the unifying theme of the book. Every Christian who is concerned to communicate, or share, his faith with those of the modern world around him, should read it thoughtfully.

Briefly, Schaeffer's point is that we can get into a position to communicate only if (a) we understand the modern world's view correctly, particularly its presuppositional base and the logical consequences thereof; and (b) we ourselves have a consistent Christian view, or coherent system, whose logical consequences are consistent with our experience. Without (a), what the world hears of the gospel from us is not what we meant by it; without (b) we have nothing unique to offer. Schaeffer has himself well communicated, using diagrams and examples that make these and many other cogent and challenging points.

The principal flaw of the book is the tendency to oversimplify. When one holds a comprehensive, or total, view of things, he is able to fit his data into neat categories in that view. It is then possible to pigeon-hole John Cage's music, Henry Miller's books, Paul Klee's art, Martin Buber's philosophy, and Karl Barth's theology with a few paragraphs each. Unless the reader is convinced of exactly the same total view of things, he is bound to feel these oversimplified discussions inadequate, misleading, or disparaging. This feeling will cause the unsympathetic reader to reject the whole book's analysis as shallow, which in spite of brevity it is not. In defense of Dr. Schaeffer on this point it is true that (a) most evangelicals would agree closely enough with him in overall view not to be derailed, and (b) he is reacting to the gross overcomplications perpetrated by the modern theologians and philosophers, who confuse simple Christian truths by semantic exercises in their attempt to inter supernaturalism.

In a brief discussion of the nature of proof there is a pregnant remark for the scientist who would communicate the gospel and be understood: A "reason why modern men reject the Christian answer, or why they often do not even consider it, *is because they have already accepted with an implicit faith the presupposition of the uniformity of natural causes in a closed system.*" (Italics his.) I do not think that Schaeffer here is rejecting a uniformitarian view of nature, for that would be dishonestly ignoring the scientific data. Rather, his emphasis is on the "closed system", i.e. without God, that most people posit. People don't see the natural laws as God's laws, so they easily accept the unwarranted notion that a scientific explanation for an event excludes God from that event. Unfortunately, many Christians have fallen into this trap as well. They are afraid to allow the possibility, for example, that the creation events of Genesis could be described by scientists using natural laws, because they mistakenly see this scientific description as excluding God. As I, and many others, have maintained elsewhere, and as Schaeffer says so well, the Christian and only the Christian has no need to fear the truth. All truth is God's, and it is the truth that sets us free.

One other feature of this book that scientists will appreciate is the emphasis on presuppositions. Of all people, scientists should be most aware of the fact that all systems of thought—scientific or philosophical—are based on assumptions. These assumptions are to be believed. They are not provable, except in the sense that the thought system built on them may be both logically consistent and conform to observable reality. Schaeffer has done the thinking Christian community a service to identify the world's assumptions and contrast them clearly with those of the Christian.

The Christian life is seen in this book as a living demonstration that there is a living God in us. The demonstration is existential as well as propositional; that is, it is true in both experience and logic. The modern world puts much stock in experience, and Schaeffer has shown both why, and indicates how the evangelical Christian may use this fact in communicating with the world. We must not ignore this divine logic or consistency of Christianity, for the gospel is true. But we must also retain the balance between propositional and existential truth. If Schaeffer seems to emphasize the propositional aspects in this book, it is probably to react against the new theologians' preoccupation with the existential.

The unique contribution of this book is in stressing the need for the Christian to understand the way the world thinks. The book will be particularly helpful to evangelical Christians and, I suspect, quite unacceptable to others for the reasons I have mentioned. The world is not likely to enjoy having the roof torn off its attempts to cover its logical inconsistencies. I would urge evangelical scientists to read it as a starting point for further less simplified study in philosophy,

the arts, general culture, and theology of today. It is easy for us to become narrowly specialized and fail to appreciate the impact of Picasso, Dylan Thomas, and others in the world to whom the Great Commission sends us today. But without this understanding of how the world hears, the things we say are bound to be misunderstood.

Reviewed by David L. Dye, Senior Scientist, A. F. Special Weapons Center, Kirtland Air Force Base, New Mexico.

MECHANICAL MAN by Dean E. Wooldridge. McGraw-Hill, New York 1968. 212 pp. $8.95.

In this book the author of *The Machinery of the Brain* and *The Machinery of Life*, Research Associate in Engineering at the California Institute of Technology and a director of TRW Inc., turns his attention to a popular exposition of the thesis: "Man is only a complex kind of machine." As the jacket states, "Drawing on recent discoveries in the fields of biophysics, biochemistry, neurophysiology, electrophysiology, and computer science, Dr. Wooldridge explores the important factors of intelligence and consciousness, as well as the physical and behavioral properties of the human organism. He concludes that all these properties, as well as the origin of life, are entirely the consequence of the normal operation of the ordinary laws of physics in inanimate chemical matter." I expect that there will be several reviews of this book on display in the Journal in the near future dealing with the technical aspects raised. Here I will simply give some general reactions to the book as a whole.

Seldom has any book of this type been such an exposition of faith as this one. At every point the faith of the author, guiding from presupposition to conclusion, is clearly in control of the material. In the early chapter on "The Origin of Living Cells", for example, where it is expected that the scientific basis for the more controversial portions of the book will be carefully laid, there are 20 examples of personal faith-judgment in the six pages from p. 22 to p. 28 alone, as exemplified by the use of such words as "may," "must (have happened)," "(such) was inevitable," "could (happen)," "likely," "ultimately," and "might (have happened)." Finally he concludes the chapter by saying, "No one pretends that such a sequence as that just outlined is a completely true description of the past. All that is claimed is that it is probably 'true to life' in that the events that it portrays are similar enough in quality to those that actually transpired to lead to generally valid conclusions about the nature, although not necessarily the details, of the prehistory of biology. . . . the principles of evolution, as we have seen, are accounted for by the laws of physics."

But this exercise of faith by the author is as nothing compared to the faith that sustains him in his treatment of the "Social Attitudes" that may be expected to follow from the understanding that man is only a complex machine. About religion, he concludes, "There is obviously no room for a personal God in a world that is rigidly obedient to inexorable physical laws. . . . This is not to say that complete atheism will be required. . . . There will be no reason why the term 'God' cannot still be used to denote the seemingly inexplicable origin of the laws and particles of physics." Arguing that there is little if any correlation between morality and the Christian faith, he says, "According to our mechanistic point of view, a tendency toward moral behavior is a genetically determined, evolutionary developed physical property of the human animal, just like the number of fingers and the size of the brain." Confronted with the record of man's history, the author remarks, "Of course, men do occasionally lie, steal, commit murder, and perform other antisocial acts. . . . Our strong innate compulsion toward moral behavior combined with the flexibility available to social institutions can confidently be expected to prevent such a result (an explosion of crime and immorality)." He recognizes that the realization that he is only a machine may have some adverse effects on man's drive and ambition, but he shrugs this off with, "some decrease in ambition and productivity may result from the general acceptance of the machinelike nature of man, but probably not much." Finally he paradoxically concludes that "the disappearance of the mystical concept of Right and Wrong . . . may result in significant increase in the logical content of human thought. . . . . Thus disappearance of the idea of absolute right and wrong will be a step in the right direction. Indeed, it may do much to diminish unreasoning prejudice and increase the likelihood of practical and peaceful solutions to the disputes that constantly arise in today's complex world."

The basic issue, of course, is whether the principle of physical reductionism can be supported. Granted that the structure of the parts that compose a man can be described in principle in terms of physics, does this mean that man, the whole, can be completely described in terms of physics as he engages in interpersonal relationships? The issue is not whether there are unique human experiences that have no counterpart in any physical or chemical process; every human experience —conversion, love, courage—*must* have some physical and chemical counterpart in the body, especially the brain. The issue, rather, is whether *everything* about man is *explained* by a physical and chemical *description;* once these physical and chemical processes have been discovered, is there nothing else meaningful that can be said about the phenomena involved?

The last words of Wooldridge's book are, "Society profits when its members behave more intelligently. And men who know they are machines should be able to bring a higher degree of objectivity to bear on their problems than machines that think they are Men." I believe the Marquis de Sade also believed that man was only a complex machine . . . . .

THE IDENTITY OF MAN by J. Bronowski. Natural History Press, Garden City, New York 1966. 107 pp. 95¢ Paperback.

In this little book the author of *Science and Human Values* turns his attention to the basic question of our day: "Can man be both a machine and a self?" He answers the question in the affirmative.

He builds his case step by step. First he points out that "in order to be unique, it is not necessary to be born unique." Then he proceeds to point out that the self is constantly in a state of dynamic change and enlargement, that "the self is not something fixed inside my head." The self comes into being in "the unending process by which I turn new experience into

knowledge."

To compare the self to a machine it is necessary to know how to define a machine. Bronowski argues that "a machine has an input, a process, and an output, and all three of these must be mechanized." In arriving at the conclusion that the self is something other than a machine, he asserts "that there is a mode of knowledge which cannot be spelled out formally to direct a machine." He calls this mode of knowledge, "knowledge of the self," that results from the recognition of the characteristics of one's own self in other selves, in a process that enlightens both oneself and the other selves involved. He considers knowledge of the self obtained by such a process to be one mode of truth, to be placed alongside scientific knowledge as another mode of truth.

Bronowski puts a good deal of emphasis on the knowledge of self obtained from vicarious participation in literature and poetry as this develops human empathy. He argues that a profound poem "does not tell us how to act, but how to be. A poem tells us how to be human by identifying ourselves with others, and finding again their dilemmas in ourselves." This is the crucial difference between a machine and a man. "Machines do not act in plays, and animals do not pretend to be other animals; they do not know how. This is what cannot be mechanized, even in principle, by any procedure that we can yet foresee."

Finally he argues that the distinction between a self and a machine is not to be found by analyzing the activities inside the body, but instead of seeing the body within its total interacting environment. This is an important point. Within any given subset of reality, there is the appearance of "machinery." The realities that transcend this machinery are to be encountered in interactions on the level of the wholes involved, and not on the level of the parts.

There are several turns of phrase memorable enough to be quoted. Consider, for example, "We know what it is like for a man to be tired, and for a dog—dog-tired; but we do not know what it is like for a metal to be fatigued."

With all the positive contribution of this book to a critical issue today, it is disappointing to find the author finally falling back upon a kind of scientific humanism. "And when we look into another man for knowledge of our selves, we learn a more intimate respect for him as a man. Our pride in man and nature together, in the nature of man, grows by this junction into a single sense: the sense of human dignity. The ethics of science and of self are linked in this value, clarity with charity, and more than all our partial loyalties it gives a place and a hope to the universal identity of man." Would that we might look into the man Jesus Christ to see there what we *might be* if our "total loyalty" to God our Creator were seen as the source of knowledge of self.

RUNAWAY WORLD by Michael Green. Inter-Varsity Press, London 1968. 125 pp. 4s 6d. Paperback.

In this attractively written popular book by the Registrar at the London College of Divinity, the charges of escapism so often levelled against the Christian faith are met head on and then for good measure turned back on those who make them. In a style and context reminiscent of that encountered in Schaeffer's books reviewed above, and also found in *Set Forth Your Case* by Clark H. Pinnock (Craig Press, Nutley, N.J. 1967), the author examines the areas of history, science, reality, and adventure.

The book is written "in the conviction that the Christian faith itself is the very antithesis of escapism." Dr. Green faces the charge that Jesus never lived with the insistence of the importance of history for Christian faith. He is willing to base a defense of the Christian position on the historicity of Jesus Christ—"a matter not of ideology or mythology but history"—and goes on to enumerate the evidence supporting this position. He challenges those who would dismiss Christians as credulous escapists to personally examine the evidence for the Christian claims—and see what happens then.

Dr. Green argues the illogicality of the value placed on man by atheists. "Jesus set a high value on persons *because* they were made by a personal God; the atheist professes high respect for persons *despite* the fact that they are the products of a quite impassive and impersonal universe. . . . If man is the outcome of a fortuitous concourse of atoms, why on earth should you *not* manipulate him as you please, provided it is in your power to do so with impunity?"

The perspective on life that finds no room for God because the world is viewed as a closed mechanistic system is labeled absurd by the author for three reasons: (1) it does not answer the ultimate question of why anything exists at all, (2) it gives no satisfactory explanation of aesthetics, ethics or freedom, and (3) even if it were true, on what basis could it be believed to be true since the perspective itself is as meaningless as anything else in such a system. In such a system morality is dissolved. It is "no longer prescriptive (telling us what we ought to do)" but is "merely descriptive (telling us what the majority desire)."

The author faces the challenges of Marx and Freud, as well as those of protagonists who view Christianity wholly in terms of the conformity of church-going. In each case his treatment is stimulating. Finally he challenges his readers to see if perhaps it is they who are running away from Christ.

This is a thought-provoking easily read book that can be recommended for personal reading and then for passing on to someone else troubled with these questions.

MAKER OF HEAVEN AND EARTH by Langdon Gilkey. Anchor Books, Doubleday, Garden City, New York 1965. 378 pp. $1.45. Paperback.

Occasionally one reads a book that can be described only in terms of superlatives. This book by Langdon Gilkey, Professor of Theology at the University of Chicago Divinity School, is one of those books. Deep enough to be satisfying but readable enough to be enjoyable, the book abounds with quotable sentences and even paragraphs.

The subtitle of the book is: The Christian Doctrine of Creation in the Light of Modern Knowledge. The subjects include a discussion of the idea and meaning of creation, and the contribution that an understanding of creation can make to an understanding of the nature of God as Creator, the intelligibility of our world, the meaning of life, the nature of evil, the efficacy of the

Gospel, the meaning of time, and the language in which we speak about God.

Particularly striking quotations from this book will be appearing from time to time in the pages of this Journal in the near future. (See p. 49.) Typical of the author's appreciation for the roles of science and Christian faith is the following:

"The whole realm of spatiotemporal facts, what can or could be observed about the created world through the sense of man, is a fit arena for scientific investigation, and in this area, for the Christian as for the secularist, scientific method is the most dependable avenue to truth. . . . And let us always remember that no *truth* about God's creation can be antithetical to Christian truth. The same God who created the world has revealed Himself in Jesus Christ; thus whatever is true about the world can be no threat to Christian faith. . . . On the other side, Christians believe that this created world, with its system of complex interrelations and its spatiotemporal facts, is dependent upon a deeper dimension of reality and being. The world is not self-sufficient, but dependent on God as its Creator and its continual preserver. Every fact and event, and every system of facts and events, comes to be and is upheld by the active, creative power of God, which continually gives to every creature its power to be in each new moment, and its power to act and relate itself to other creatures."

Although oriented in a Neo-orthodox perspective, as becomes particularly evident in some of the treatment of the Scriptures in the final chapter of the book, Dr. Gilkey brings to bear on the many fundamental problems he treats a perceptive understanding of the Christian faith and of the disciplines with which it interacts. This is a book that should be part of the background of every reader of this review.

THE CHRISTIAN STAKE IN SCIENCE by Robert E. D. Clark. Moody Press, Chicago 1967. 160 pp. $3.50

Dr. Clark is a British scientist who served for three years as a scientific editor for Paternoster Press and who is the author of several books relating science and the Christian faith. In this book he has tried to avoid each of three historic positions taken in this area: (1) seize upon scientific findings and use them indiscriminately in defense of Christianity; (2) speculate freely but never communicate our conclusions to others; (3) exercise to keep our minds and lives compartmentalized with science and religion neatly separated to avoid conflict. Dr. Clark argues that if the historical record is examined impartially, it will become evident that most of the time the Christian expectations have been borne out by the progress of scientific investigation, whereas the atheistic or secularistic expectations have not.

To a considerable extent, Dr. Clark is successful in this undertaking. He points out how the Christian expectation has proven accurate in the areas of the limitations on scientific method, the persistence of gaps in knowledge, the inability of science to solve all of man's problems, the humanization of science and its emphases, and the significance of the contingent in the historical record. Even in these cases, however, it is not clear how much of the credit Dr. Clark bestows upon Christian foresight is not more properly identified with Christian hindsight.

In other areas, Dr. Clark's efforts and examples stray somewhat far afield from what might be considered a moderate viewpoint among Christian men of science today. He argues that Christians, contrary to atheists who expected that all kinds of matter were known, have always held that strange forms of matter exist. He goes on to identify the concept of the "ether" with that "half-way" substance that permits interaction between spiritual and material. He puts fairly heavy weight on the reality of psychic phenomena, arguing that evidence for the direct action of mind on space is given by the appearance of ghosts, poltergeists—and many of the miraculous biblical appearances. He argues for the uniqueness of man partially on the fact that psychical manifestations have never been found among animals. Mental telepathy to him is so well established that, not only do all Christian accept it, but all atheists as well!

Among other statements that reflect a somewhat aberrant viewpoint are the following: it is quite possible that "the mind is, rather literally, a 'ghost in a machine' "; "the Piltdown forgery was motivated by a desire to spread Darwinism;" "the suggestions that the (Genesis) revelation was made in a series of visions given at night . . . has much in its favor;" "at the Biblical date (of creation of man), God gave to man a new nature conferring on him a god-like quality of mind and fitting him to take dominion over the earth . . . there is no need to identify the tool-making man of prehistory . . . with man in the image of God;" the synthesis of certain organic compounds by subjecting a mixture to ultraviolet light or electric discharge "arose as a result of atheistic thinking."

Dr. Clark's book contains many helpful emphases for the Christian, but it is doubtful whether the non-Christian scientist in particular will react in the way that Christian expositors of this field would desire.

The review of The Christian Stake in Science *was originally published in* Eternity, *July,* 1968, *p.* 45. *Reprinted by permission.*

Reviewed by Richard H. Bube, Dept. of Materials Science, Stanford University, Stanford, California.

Communications*

Suggested Name Change for A.S.A.

I believe that the ideas, discussions, and philosophy of the A.S.A. could more readily be promulgated in other parts of this world if our organization and its publication were not "burdened" with the word "American" in its name.

In the present era of rebellion and revolution around the world, it is all too popular to be anti-American and prejudiced against everything which emanates from our country. Having lived in Europe, specifically Sweden, for six years now, I am perhaps more acutely aware of the animosity which prevails. American churchianity is a particular target for ridicule by Europeans who like to associate our national weaknesses with the hypocrisy of our so-called christians.

Though I love my country, its heritage, the flag, etc.. I do not think I am unpatriotic when I suggest that the cause of our Saviour is best served globally when we avoid those encumbrances which put people off and are *in addition to* the unavoidable stigma of the Cross. Paul says that we are *citizens of Heaven* (Phil. 3:20, J. B. Phillips) and I believe that when we take this literally it affects our outlook and our involvement in the needs of the world. We are Christians, who incidentally happen to be Americans (and that through no initiative of our own). Missionaries, overseas laymen, and organizations which keep those distinctions in the right sequence usually are more effective and less apt to be tagged as "ugly Americans".

It is difficult to gain acceptance for the ASA Journal by university libraries, professors, and students because of its clear American identification. It is difficult for interested laymen overseas to try to establish local chapters or committees of the ASA. Yet the concept of the ASA and the ideas and discussions set forth in the Journal are so desperately needed in all parts of the world. Of course there are a few organizations similar to the ASA in other lands, but to my knowledge they are just as provincial as the ASA. Why not broaden our horizons and set out to establish a world-wide "ASA"? Why not move out to universities and scientific centers across the world and there do battle for the cause of Christ our Saviour? I have met outstanding European scientists and engineers who have a clear Christian witness and who could undoubtedly contribute significantly to writings in the Journal and who would be strengthened by association with their American counterparts.

So, I am really asking for more than a name change —it must be a change in dimension of our outreach. Other evangelical American organizations are already facing this challenge—the ASA must, too.

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*Communications of all sorts: letters, short comments, poems, responses, reactions and just plain sharing—are invited for this section of the Journal. Such contributions should not exceed *one page* in length. The Editor reserves the right to publish here all letters addressed to him, unless specifically requested otherwise by the author.

Dialogue

Listen,
Others in the Universe are speaking.
Listen,
But listen not for sounds alone
For some creatures make no sound.
Listen,
Do you hear the communicating throb
of love?
Not in sound or light
But in communion of like spirits
Eagerly awaiting the other's sacrificial offering,—
A portion of its life, its soul.
Listen,
Do you hear the voice of a symphony?
A granite mountain—a voice of grandeur.
The ocean—a volume of history.
All molecules.
All molecules?
Yes, each has its peculiar song.
Resounding.
One hundred and four elements combine
their fine tuned voices,
A universal choir.
Singing, giving themselves to each other.
Listen,
Have you found your place?
The Creator longs to hear His childrens'
voice
When they recognize His, and know
Their Identity.

J. G. Ashwin
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A Test for Biblical Relevancy

Dr. Maatman's thoughts (*Journal ASA* 20, 119 (1968)) concerning the importance of our understanding of the relation between science and the Bible raised a point of great importance. While discussion often takes place on the issue of evolution, the real issue is

not evolution, but rather how much adjustment a Christian can tolerate in the biblical record. As Maatman says: "If evolutionists and anti-evolutionists cannot agree on the relevancy of the Bible for this question, neither will they be able to agree on its relevancy for other science-faith questions." I believe that it is this, perhaps unconscious, realization that has led so many members of the ASA to view the evolution issue as one of primary importance.

Since the basic issue is what one should do when there is an apparent discrepancy between scientific findings and the scriptural record rather than whether evolution took place in the development of man, I would propose that this basic question be decided on a discrepancy much easier to defend scientifically than evolution. This discrepancy is the age of the earth. While scientific data lead to an age in the billions of years, the biblical record leads to an age in the thousands. It should be possible for the ASA to come to a general agreement on how to handle this discrepancy since there appears to be little likelihood that the scientific value for the age of the earth can ever be reduced to the thousand-year level. Once the principles of reconciliation can be worked out on this problem, they should then be applied to the evolution question.

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Evolution Not Open to Racism

After reading the contribution by Russell Maatman on "Biological Evolution" (*Journal ASA* 20, 119 (1968)), I took note of a series of statements, which leave much to be desired.

His statement that the "evolutionist allows for differences between groups of men, depending upon how far along the evolutionary path each group has travelled", which "leaves the door open to racism" is indeed in error. We must first look at the purpose of the A.S.A.

> "The A.S.A. studies relationships between Christianity and science in the conviction that the *frameworks of scientific knowledge* and evangelical Christian faith are compatible."

With this in mind, we could say we have two classes of evolutionists, the informed and the uninformed. The informed evolutionist is the scientist, the anthropologist, archaeologist, ethnologist, sociologist. The uninformed evolutionist is the one who does not take the time to study his position. Therefore, the latter's view is not within the "*framework of scientific knowledge.*"

To quote Clifford Geertz, Assoc. Prof. of Anthropology, Univ. of Chicago, ("The Transition to Humanity", *Horizons of Anthropology,* edited by Sol Tax, 1964.)

> "The established fact that there are no significant differences in innate mental capacity among the living races of man is not contradicted, but if anything supported and deepened by the postulation of differences in the capacity to acquire culture among different forms of presapiens men. The physical divergence of the human races is, of course, a very recent matter, beginning perhaps only fifty thousand years or so ago, or, by the most conservative estimates, less than one hundredth of the length of the whole hominid, i.e., man forming, line. Thus mankind has not only spent the overwhelming proportion of its history in an altogether common evolutionary process, but this period now seems to have been precisely the one during which the fundamental features of its humanity were forged. Modern races are just that: modern. They represent very late, and very secondary, adaptation in skin color, facial structure, etc.—probably mainly to climatic differences—as Homo sapiens dispersed throughout the world toward the close of the glacial period."

When we speak of mankind, we must, therefore, throw "race" out the window, for, truly, no such thing as race exists. We are all of one, and only one, species, *Homo sapiens,* evolving from one common ancestor.

If one still insists on using the term "race" to distinguish peoples, he must then refer this definition to cultural, *not biological,* development. To this most can subscribe, being basically ethnocentric, that there exist cultures, at a lower cultural evolutionary level, but certainly not men on a lower biological level.

Without expounding at great length concerning my own views, I visualize the biological evolution of mankind as the most beautiful, most Divinely guided, and obviously the most important of all of God's creations, and if this view is not compatable with the Bible, I pray that God will show me the way.

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Reply to Preis

I appreciate Mr. Preis' concern. If I were to accept the evolutionary principle, I would certainly vigorously oppose any suggestion that this principle might be responsible for even a small part of today's racism.

But I think I see this picture: On the one hand, evolutionists teach both within and outside of the scientific community the principle that life evolves. This widely-accepted principle is broader than the sum of specific cases cited as proof of the principle. On the other hand, a few scientists and many non-scientists have used this principle to fortify an observation they think they have made, namely, an observation that some "races" are mentally inferior to others.

Thus the evolutionary principle provides a certain intellectual climate. Those responsible for the creation and continued existence of this climate certainly cannot be held responsible for every use made of the evolutionary principle. But is it not incumbent upon evolutionists to *delimit* their principle? To claim that all men are on the same level is not enough. Such a claim seems to be based on empirical evidence, not theory. Why are there not other forms of men? Are evolutionists convinced that evolutionary *theory* can be used to prove that no other forms of men have survived?

I hope that the different views expressed by Mr. Preis and me illustrate a point I attempted to make in my article. I want us to realize that differences of opinion on evolution in the ASA are fundamental, and that these differences affect our approaches to seemingly—unrelated problems.

Russell Maatman
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Archaeology and the Bible

I read with interest the letter of Dr. William F. Campbell (*Journal ASA* 20, 122 (1968).

Perhaps some of the titles are already familiar, but the following are some (inexpensive) works on the subject of archaeology and the Bible:

1). F. F. Bruce. *The N.T. Documents: Are They Reliable?* London: Inter-Varsity Fellowship, 5th ed. 1960, 128 pp.

2). Allan A. MacRae. *Biblical Archaeology.* Marshallton, Del., 19808 [Box 5103]: Natl. Foundation for Christian Education, 1967, pp. 58.

3). E. Jerry Vardaman. *Archaeology and the Living Word.* Nashville: Boardman Press, 1965, 128 pp.

4). Howard F. Vos, ed. *Can I Trust the Bible?* Chicago: Moody Press, 1963, pb. 1968. This contains the following chapters: 1) Gordon H. Clark, "How May I Know the Bible Is Inspired?"; 2) Frank O. Green, "Can We Believe in the Miraculous?"; 3) Edson R. Peck, "Does Science Contradict the Bible?"; 4) R. Laird Harris, "What Books Belong in the Canon of Scripture?"; 5) Robert D. Culver, "Were the O. T. Prophecies Really Prophetic?"; 6) R. Laird Harris, "How Reliable Is the O. T. Text?"; 7) Meredith G. Kline, "Is the History of the O. T. Accurate?"; 8) A. Berkeley Mickelsen, "Is the Text of the N. T. Reliable?"; 9) Robert H. Mounce, "Is the N. T. Historically Accurate?"

5). Edwin M. Yamauchi. *Composition & Corroboration in Classical & Biblical Studies.* Philadelphia: Presbyterian & Reformed Pub. Co., 1966, 38 pp.

6). In a more expensive volume are two articles on archaeology and two on biblical criticism. Carl F. H. Henry, ed. *Revelation and the Bible.* Philadelphia: Presbyterian & Reformed Pub. Co., 1958.

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Letter to Editor of *Physics Today.*

I have sent the following letter to the Editor of *Physics Today*:

"The "unifying synthesis" your reviewer failed to find in R. H. Bube's "The Encounter Between Christianity and Science" (*Physics Today,* Jan. 1969, page 103) is quite subtle. It involves, as he said, attitudes; but, more importantly, presuppositions. Since science and Christianity deal with different aspects of truth, one wouldn't expect them to have the same operating presuppositions. Hence a disparity in content and method. But since they both deal with truth, though differing aspects, their presuppositions should not contradict, nor lead logically to contradictions. Hence a unity, to wit, a recognition that there is truth to be understood and apprehended.

The physical world we presuppose (1) is in some sense really there to be observed, (2) is describable in logical (mathematical) terms, and (3) is causal enough, if not deterministic, to allow meaningful verifications of theories by experiment. The science built on these assumptions converges to a description of a true physical, i.e., observable, universe.

The Christian presupposes: (1) that there is some ultimate meaning beyond mere description, and (2) that Jesus Christ revealed to man the characteristics of that ultimate meaning. Careful study of the New Testament leads me to conclude that assumption 2 authenticates the Biblical record as inspired, although others may hold this to be an independent third assumption. Based on these presuppositions the Christian view is then that Christ showed us a reality beyond the physical, which we may call the Spiritual, and with which we human spirits interact. Jesus taught that we must interact with God to have a satisfactory experience of life. The concept and nature of God, and the means of interaction and personal relationship, were the principle features of the ministry of Jesus. (The social and behavioural implications of a man's right spiritual relation with God are what most people now emphasize in religion, however.)

Thus the assumptions underlying science and Christianity are a possible consistent set, and form a basis for a unified synthesis, a comprehensive view that allows full intellectual integrity in science and that recognizes revealed spiritual realities beyond mere physical description. Such a view sees the natural laws as God's laws.

Bube's book recognizes the reality and importance of physical world truth and also of spiritual world truth. Thus there is in his view the unity of truth. Whether one feels the book has demonstrated it, of course, depends largely on one's acceptance and view of the Christian assumption #2."

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Latin American Universities

I have greatly appreciated the new emphasis of the Society and the Journal, as I feel it speaks more closely to our needs here in Latin America than formerly. I am enclosing a memo prepared to answer a number of inquiries regarding university (or high school) teaching on a free-lance basis here in Latin America. This information is available to anyone interested who will write to me to request it. I would be happy to supply the memo. Thank you in advance for anything you can do.

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Freedom Now: A New Journal

Many people believe that complete integration would provide freedom for the Negro. This is a serious mistake. The Bible says, "And ye shall know the truth and the truth shall make you free." Complete integration, removal of all forms of discrimination, improved educational facilities and the destruction of poverty would not provide freedom now. Only salvation through Jesus Christ and the application of His message to every aspect of life can bring true freedom. So the responsibility of every Christian is to preach the Gospel of Jesus Christ in its fulness.

Many other people believe that a simple salvation message would provide freedom now. This is also a serious mistake. By all means there must be a simple salvation message, but to provide complete freedom now, the whole gospel of Jesus Christ must be preached

and practiced. To practice the whole gospel of Jesus Christ means, we believe, to have integration, to remove all forms of discrimination, to improve educational facilities and to fight poverty. Many sincere people feel that this is the old social gospel. But surely the gospel of Jesus Christ is partly social for it touches every phase of an individual's life, not just the "religious" phase. Surely being born again means being born again in the whole man, political, social, economical, personal etc. The truth which makes men free makes their whole life free.

This Journal (*Freedom Now*) is dedicated to the cause of Freedom Now in the above two aspects. It will be especially directed to the white fundamentalist with a deep desire that it might also be a blessing to our Negro Christian brethren as together we endeavor to make Christ known to ALL AMERICANS.

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Fred A. Alexander
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The Unreasonable Effectiveness of Mathematics in the Natural Sciences*

We are indebted to modern science for an entirely new insight into the question of the extent to which we can interpret man as bearing the image of God. I am indebted for this insight to a fascinating paper by a winner of the Nobel prize in physics, Eugene P. Wigner, with the title "The Unreasonable Effectiveness of Mathematics in the Natural Sciences" (*Communications on Pure and Applied Mathematics,* XIII (1960), pp. 1-14). The main point of this paper is to comment on the numerous occasions in the history of physics since Newton in which a mathematical system, originally a pure product of the human mind, has subsequent to its development proved remarkably applicable to an accurate description of nature. Since nature is certainly not itself a product of the human mind, the correspondence between the mathematical system and the structure of things in the natural world has a kind of miraculous quality about it. It is not something we would ever have anticipated in advance, and it is a fact which escapes our understanding.

The first instance in which the truly amazing character of this correspondence confronted mankind was the combination of second order differential equations with the remarkable properties of quantities which vary inversely as the square of the distance from a point. This combination constitutes Newton's formulation of the law of natural gravitation and of the motion of bodies under it. Of this Wigner says,

> "Philosophically, the law of gravitation as formulated by Newton was repugnant to his time and to himself. Empirically, it was based on very scanty observations. . . . The law of gravity which Newton reluctantly established and which he could verify with an accuracy of about 4 percent has proved to be accurate to less than a ten thousandth of a percent and become so closely associated with the idea of absolute accuracy that only recently did physicists become again bold enough to inquire into the limitations of its accuracy."

Another miracle of this sort left an indelible impression on the great physicist Albert Einstein, who first experienced it in the development of his General Theory of Relativity. Well before he undertook this task, a very beautiful general mathematical theory of multidimensional curved spaces had been developed by Riemann, Christoffel, and a number of other mathematicians. The theory was expressed in tensor form, which makes the geometrical properties of the space independent of any particular choice of coordinate system in which it is expressed.

What Einstein required was a symmetric tensor involving only the geometric properties of the four dimensional space-time, which when equated to the tensor defining the distribution of matter would lead to ten equations. Solutions of these ten equations would then describe the motions of bodies in any type of gravitational field. What he found was that in the Riemannian geometry of a four dimensional space there was only one symmetric tensor of the right properties and that this tensor had indeed just the required ten components. It was all or nothing. There was one and only one possibility for a correspondence between the mathematical system in the mind of man and the distribution of matter in the natural world. Yet it led to a set of gravitational field equations whose solutions do in fact correctly and accurately describe the way bodies in nature move under the influence of each others' gravity.

Wigner concludes his paper with the words,

> "The miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve. We should be grateful for it and hope that it will remain valid in future research and that it will extend, for better or for worse, to our pleasure even though perhaps also to our bafflement, to wide branches of learning."

Now we have discovered that systems spun out by the human brain, for no other purpose than our sheer delight with their beauty, correspond precisely with the intricate design of the natural order which predated man and his brain. That surely is to make the discovery that man is amazingly like the designer of that natural order. How better describe this discovery than to assert that man is indeed made in the image of God!

*Reprinted from Chapter 4 of *Man on a Spaceship,* by William G. Pollard, The Claremont Colleges, Claremont, California (1967)

What Do You Think of THAT?!*

The Draft

In an address delivered November 11, 1968 before the American Legion in Rochester, New York, W. Allen Wallis said, "The draft is immoral in principle, inequitable in practice, and detrimental to the national security. The first thing the new administration should do is start to stop it. . . . . Nothing is more opposed to our ethical, religious, and political principles than taking bodily control of a person and forcing him to submit totally to the will of others." The draft is becoming more rather than less serious in its effects on the educational process: nearly half of all male graduate students in the sciences will be eligible for the draft this year. (*Science* 163, 235, 264 (1969))

UFO's

A paperback edition of the final report of the first extensive study of unidentified flying objects, entitled *A Scientific Study of Unidentified Flying Objects,* has been published by Bantam Books. Dr. Edward U. Condon was the scientific director of the project, and he concludes that nothing has resulted from a study of UFO phenomena in the past 21 years that has added to scientific knowledge. The hypothesis that UFO's are the result of visitations by intelligent beings from outer space is supported by no evidence. If anyone could prove that UFO's are piloted by such space visitors he could be assured of a Nobel prize. (*Science* 163, 260 (1969))

Sex Switching

The adopted son of actress Dame Margaret Rutherford has undergone sex change treatment at John Hopkins University Hospital in order to become Dawn rather than Gordon Langley Hall. Dr. William Standish Reed contends that a Christian should not participate in sex change treatment if this is initiated for psychological rather than physical reasons. He argues that once a man or a woman comes to faith in Christ, he will no longer desire to change sexes. "Certainly the desire to change one's sex is primarily a spiritual problem, not a psychiatric one. It may indeed even be demon-possession." (*Christian Life*, February 1969, p. 20)

*This feature is intended to stir reader reaction in the hope that such topics may be explored in more detail in future issues of the Journal. Contributions are warmly invited.

What Do You Think of THAT?!

Big Brother TV?

In a recent issue of Playboy Magazine, Marshall McLuhan describes mankind's participation in the three major revolutions in communication to rock the world in the history of man: (1) the phonetic alphabet, (2) the printing press, and now (3) electronics. Television in particular is singled out for its revolutionary effects on politics, education, democracy, and human society. Is McLuhan right that mankind will surrender all traditional moral, social, political, and cultural values to the all-encompassing control of Big Brother TV?

One Year After the Kerner Report

A report called "One Year Later" has been issued by Urban America, Inc., and The Urban Coalition, nonprofit Washington organizations concerned with city problems. It is not encouraging, concluding with the words, "A year later, we are a year closer to being two societies, black and white, increasingly separate and scarcely less unequal." The passage of a year finds increased apartness, continued failure to provide needed jobs, lack of enforcement of non-discrimination in government contracting, failure of education in the slums and ghettos, and falling short of much-needed housing for the poor and minorities. Are there successful programs where Christians are involved and effective?

Contraceptive Revolution

In a talk on "The Identity Problem of the American Woman" at the 70th anniversary of the Women's Athletic Club in Chicago, Clare Boothe Luce suggested that the "contraceptive revolution may yet prove to be the greatest revolution in mankind's history." She contended that the contraceptive revolution has challenged the most ancient concepts of woman's nature. Coupled with the industrial revolution, the change in woman's position from a producer of domestic goods to a consumer, and modern psychoanalysis that has produced a generation of men with hangups on motherhood and fatherhood, woman finds it harder than ever to secure the traditional joys of husband, home, and children. There is still hope, however, according to Mrs. Luce—in supersexiness!

In September, 1941, five scientists of deep Christian conviction met together in Chicago. They found that they shared mutual concerns in the relationship of science and Christian faith. The **American Scientific Affiliation** is an outgrowth of that meeting.

ASSOCIATE MEMBERSHIP is open to anyone with an active interest in the purposes of the Affiliation.

MEMBERS hold a degree from a university or college in one of the natural or social sciences, and are currently engaged in scientific work.

FELLOWS have a doctoral degree in one of the natural or social sciences, are currently engaged in scientific work, and are elected by the membership.

Members of the Affiliation endorse the following statement of faith: The Holy Scriptures are the inspired Word of God, the only unerring guide of faith and conduct. Jesus Christ is the Son of God and through His Atonement is the one and only Mediator between God and man.

DUES for these three types of membership are: Associate $7.00, Member $10.00, and Fellow $12.00, per year. A member in any of these three categories can take the *special student rate* of $3.00 per year as long as he is a full time Student.

PUBLICATIONS include the ASA News (sent to all members four to six times each year); two symposia: *Modern Science and Christian Faith*, F. Alton Everest, Editor, Van Kampen, Wheaton, Illinois (1950) (out of print), and *Evolution and Christian Thought Today*, Russell L. Mixter, Editor, Eerdmans, Grand Rapids, Michigan (1960). Individual authors are also encouraged to publish independently when this seems desirable.

LOCAL SECTIONS of the American Scientific Affiliation have been organized to hold meetings and provide an interchange of ideas at the regional level. Information may be obtained from the persons listed below or from the national office.

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Membership application forms, ASA publications and other information may be obtained by writing to: AMERICAN SCIENTIFIC AFFILIATION, 324½ So. Second St., Mankato, Minnesota 56001.