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MAN AT THE THRESHOLD OF SPACE

Are we at the beginning of a golden era — or can we expect the submergence of all human values?

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For more than 50 years some writers and thinkers have been concerned about the consequences to humanity of allowing science to run roughshod over all facets of life. From Jules Verne to George Orwell they have painted a grim picture of life under a scientific dictatorship. As one reads these books it is surprising to realize how many of their prophecies have already come to pass and, consequently, to wonder if we are inevitably heading for one of these dreary, negative "utopias."

Today we are on the threshold of space. Science and engineering together have solved the problem of permitting man to step off his little planet into the emptiness of the solar system. Does this dramatic event presage the beginning of a golden era, or the submergence of all human values?

First, let us consider exactly what is meant by saying that we are at the "threshold of space."

It is now about six years since the Soviets startled the world by announcing that they had a satellite in orbit. I am sure that many of you remember the excitement produced by the first Sputnik on October 4, 1957. The Soviets had arranged to have a short-wave transmitter on the Sputnik so that people all over the world, with reasonably good short-wave receivers, could listen to the satellite and assure themselves that it was indeed in orbit. Furthermore, the radio signals reported instrument readings from space, so scientific data were being collected for the first time from far above the surface of the earth.

I will not concern myself here with the political repercussions of this event, but I do want to note two important thought processes which I think this first Sputnik generated. First, it showed conclusively that the earth is round and, secondly, that the earth is not very big.

As we all know, at the end of January 1958 the United States launched its first satellite – very much smaller than the Soviet satellite to be sure, but nevertheless a good scientific satellite – and with this launching the "space race" was on.

How much the space program has grown can be illustrated by the budget of the National Aeronautics and Space Administration. Starting from almost zero in 1958, it has grown to $3¾ billion in the current fiscal year, and NASA has asked for $5½ billion in the next fiscal year.

The space program has spent a tremendous amount of money with the support and approval of the Congress and I suspect the Soviets have spent comparable amounts of money. What has come about as a result of these expenditures? First, the close-in earth satellites: During these six years, the size of earth satellites has grown from a few pounds to a few tons. Satellites have carried scientific instruments of a wide variety; they have carried biological specimens; they have carried a man into orbit.

As a result of these satellite firings, a great deal of scientific information has been gathered. We have a wealth of knowledge now about the extreme upper reaches of the earth's atmosphere, of the environment in space in the near vicinity of the earth, of the appearance of the earth from a satellite looking down on the earth – and, indeed, even of such things as the exact shape of the earth, because it turns out that the path of a satellite in orbit can give us a very precise measure of the exact gravitational configuration of the earth. The first U. S. satellites discovered the Van Allen radiation belts which surround the earth and which are of considerable interest in a practical sense because of the radiation hazard which they portend for space travelers and explorers who may tarry too long in those regions.

The satellites have also produced practical results. For example, we have such things as the Echo satellite, the Telstar satellite, the Tiros satellite. These first two demonstrated the capability of satellites to be used for communications purposes. There is no doubt whatever that in the future there will be a growing interest in satellite communications. In fact, satellites will probably be the only economically feasible answer to the growing load of transoceanic telephone communications.

Tiros first showed what could be done by looking down at the earth from a satellite. It gave the meteorologists a great deal of new information about weather and cloud formations over the earth. Undoubtedly, Tiros is only the first in a series of meteorological satellite developments which should lead not only to a better understanding of weather phenomena, but also to more accurate weather forecasting. The next satellite in this series is called Nimbus, and will be flown next year.

Deep space exploration

A second area of space exploration has been the area of deep space exploration, to the moon and to the planets. Both the Soviets and the U.S. have conducted experiments in deep space; the Soviets have successfully launched four space probes towards the moon (Luniks I, II, III and IV), with varying success. Lunik III is probably the most interesting because this succeeded in taking some photographs of the back side of the moon; poor photographs to be sure, but nevertheless showing a portion of the moon never before seen by human eye. The U. S. has launched three spacecrafts towards the moon – Rangers III, IV and V, of which Ranger IV actually landed on the moon – but none of the three accomplished their scientific missions.

In the planetary area, the United States successfully launched Mariner II towards the planet Venus in August 1962. Data were received during the entire journey to Venus and also scientific observations were made of the planet as the spacecraft passed nearby. In November 1962 the Soviets launched a space probe towards the planet Mars, but they lost communications with it in March 1963, when it was little more than halfway to the target.

These deep space experiments have given us much scientific information about the environment of deep space, about such things as the solar plasma, the magnetic fields, and the micrometeorites to be encountered in journeys through space. With Mariner II we also began the exploration of another planet by instruments placed near the planet.

In the area of technology, the investment in space has accomplished a number of very important things. First of all, it has given us a much greater insight into the problems of very complex systems. If we are going to conduct a space experiment, whether it is an astronaut going into orbit or a planetary probe going to Venus, we find ourselves dealing with a complex system involving large numbers of people and very large amounts of equipment, much of it automatic. The understanding of such complex systems is an important byproduct of the technological developments in space. Similarly, our space program has improved the art of rocketry because of the requirements on the space program of conducting rocket firings from parking orbits or from space probes after traveling great distances from the earth. The general techniques of rocketry have been advanced considerably as a result of the program. In the field of communications, the space program has required the ability to communicate over the vast distances, not only to the moon but even to the planets. This is something which would have been utterly inconceivable only a few years ago and it is really a remarkable achievement.

Likewise, space technology has taught us a great deal about the design of instruments. The requirements for operating in space, the requirements of reliability, of operating in limited weights and volumes – all of these things have taught us how to build better instruments, and much of this technology will be applied in other areas.

Sending a man to the moon

If we look to the future of space, the first and obvious thing, of course, is that we are engaged in the attempt to send a man to the moon and recover him successfully. This is the most difficult engineering task which has ever been attempted by any people anywhere. It is going to require very large rockets, very complex engineering systems, and it is indeed going to be a very expensive undertaking. The nation is committed to this and, as we all know, work is now seriously under way. I assume that the Soviets are likewise interested in sending a man to the moon, and I suspect that they also will be investing the same sorts of resources in this kind of project.

In addition to the lunar program, however, I think we should remember that there are many other scientific areas of space exploration which will be investigated to an increasing extent as time goes on. The exploration of the planets, for example, is obviously a most fascinating area of scientific investigation. The discovery of life on another planet would be one of the most exciting scientific discoveries of this century.

We must conclude that the space program, taken as a whole, is a continuing dramatic illustration of the advance of technology and science. The program requires the exercise of the utmost ingenuity to solve the technical and other problems. Success in space is therefore a clear demonstration of technological capability of the highest order. We are living in a civilization in which technological capability is an important index of success, and so a successful space program becomes an asset valued in national policy. Hence, we have the USA and the USSR supporting ambitious space programs. Other nations strive to enter the space arena. Western Europe is actively working on a cooperative project. Many smaller countries are helping in various ways. We are truly entering the space age.

Quite obviously, science and technology together are making very rapid changes in our way of life. Nothing like this has ever happened before, although the general ferment of thought associated with the Renaissance made almost as rapid changes in intellectual areas as the present developments have made in our material surroundings. I should, therefore, like to consider why this rapid scientific growth came about, what is sustaining it, and why it happened at this particular time.

Science in classical times

If we go back to classical times, we find a considerable interest in what we now call the physical sciences and mathematics. In fact, Greek thinkers contributed much of the basic knowledge which we still use. Euclid, with his geometry, established a body of knowledge which is still in use. Eratosthenes performed an experimental measurement of the radius of the earth which was surprisingly near the correct value. Democritus proposed an atomic theory which sounds very modern in many aspects. Back in Babylonian days astronomers, or rather astrologers, had a reasonably good observational familiarity with the heavens and were able to predict eclipses.

In spite of all this, science did not advance. Perhaps the principal reasons were a lack of appreciation of the universality of scientific truth, and of the value of experiment. Many classical scientists were mere catalogers, gathering data from hearsay and drawing doubtful conclusions therefrom. Consider the obvious errors in Pliny's *Natural History* or in the works of Aristotle.

Modern science begins with the Renaissance. The spirit of inquiry and the questioning of authority which marks this era extended into the scientific field. Men like Kepler, Copernicus, and Galileo began to make careful observations and perform careful experiments. There may be some doubt as to whether Galileo actually dropped two different weights off of the leaning tower of Pisa, but he certainly performed the experiment somewhere. It is a remarkable thing to realize that, though Aristotle said that a heavy weight would fall faster than a light one, no one performed this simple experiment until Galileo tried it and proved Aristotle wrong about 1900 years after he said it.

Newton and modern science

Newton was born in the year Galileo died, in 1642. With this man, modern science truly begins. His principles of mechanics, his law of gravitation, his experiments in optics, his developments in mathematics made him the outstanding scientific figure of the 17th century. His work has stood the test of time and still forms the foundation of our engineering work, from bridge building to rockets and satellites. The importance of Newton from the standpoint of the development of science is not that he made some remarkable discoveries, but that he developed a new approach to science, and that other men, his contemporaries and his followers, continued to use his methods.

Newton's approach is based on the idea that there are universal physical laws, that scientific truth is absolute and the laws of science are everywhere the same. A second point is the idea of proceeding from the particular to the general; in other words, the application of the inductive method. A third point is the importance of experiment; scientific truth is subject to experimental verification and can only be determined from careful experiments. Finally, scientific truth requires mathematical analysis for precise understanding and exact statement.

Based on these considerations, and particularly emphasizing the necessity for experiment and mathematical analysis, science began to develop rapidly in a variety of directions. There is no need to attempt to itemize the milestones of progress except perhaps to note that, as Newton developed the science of mechanics, so did Maxwell in the 19th century develop electricity and magnetism. With his great synthesis the 19th century picture of the physical world appeared to be complete; only the details remained to be filled out. However, a few years later experiments began to show discrepancies, and in the early 1900's Planck laid the foundation of quantum mechanics and Einstein proposed his relativity theory, building on to the laws of Newton and Maxwell the necessary modifications to describe the physics of the atom and of the universe.

And so it was in all fields of science. The initial steps taken in the 17th century served to start the rapid growth which has led to our present scientific heritage.

Our technological development is closely related to the development in science, simply because the understanding of scientific principles points the way to the utilization of these principles. In other words, the scientist is interested in discovering facts about nature, and the engineer is interested in using these facts to build something useful. And so by the 19th century we have the beginning of what we call the Industrial Revolution.

The Industrial Revolution

The first phase of the Industrial Revolution was essentially the application of power, other than human or animal, to operate machinery. At first this power principally replaced manual labor because it was cheaper and produced more goods. For example, the application of power, and the appropriate machinery, to the textile industry was the first important advance. However, it was soon realized that power machinery could also do more precise things than even a skilled craftsman, and many of our manufactured goods could not possibly be produced without these precision machine tools today. Finally, power machinery can do some things which are absolutely impossible with human or animal power. For example, the ability to pack a great deal of energy into a small space has made possible the airplane.

This phase of the Industrial Revolution has been responsible for most of the everyday technological devices we see around us. As power sources developed from large, inefficient, water or steam engines to small, efficient, electrical or internal combustion engines, whole new areas of application developed likewise. Now we are on the verge of widespread application of nuclear power plants. Although these will probably always be large and heavy, the potential of almost unlimited power production with negligible amounts of fuel must inevitably bring about further developments and applications.

The next phase of the Industrial Revolution is the cybernetics phase or the development of automation. We are now in the rapidly developing part of this phase. Automation depends on the fundamental principle of feedback. The machine is asked to compare its output, whatever that may be, against an expected output, and to stop working when it has reduced the difference to zero. A simple example is a thermostat in your house; the furnace stays on until the output (the temperature of the room) matches the desired output (the setting of the thermostat) and then it turns off.

The principle of feedback can be applied in numerous ways and with astonishing results. For example, automatic devices may replace skilled labor just as power machinery replaced unskilled labor. Automatic machinery has been used to run an oil refinery, to operate a power plant, even to operate a subway train. But automatic devices can also accomplish tasks to a much higher precision in much less time than a human operator, as in a guided missile which seeks out its target. Furthermore, automatic devices may operate using sensors which detect radiation, for example, to which a human being is not sensitive. Thus the control of nuclear reactors must be done by instruments that work in a region which would be a lethal environment to man.

The effects of automation

Although we are still in the early phases of this development, it is already clear that it will have just as great national and social consequences as the power phase of the Industrial Revolution. The earlier phase initially affected small craftsman, who were replaced by semi-skilled machine operators and large factories. Later it affected unskilled laborers, whose work was done more efficiently by large power machines. In the new phase of automation, skilled labor and white collar workers who have been engaged in simple repetitive work will now be replaced by automatic machines.

I do not believe there is any need to stress the reasons for the rapid growth of technology. Quite simply it is that machines do more things cheaper and better than manual labor. For example, today it costs about five times as much to dig a ditch by hand as it does to do the job by machine. In more skilled trades the difference is, of course, even greater than this — provided only that there is enough work to be done to keep the machine busy.

Improvements in machines and the introduction of automation continually decrease the number of man hours of labor necessary to manufacture goods or to raise and harvest agricultural products. It is estimated that since 1900 the productivity of labor in the U.S. has increased by a factor of three. As a specific example, in the General Electric Company over the years 1956-59, production was up 8 percent, but the number of workers decreased 25 percent.

In highly technical industries, developments go through a cycle of research investigations in the laboratory, to a pilot-plant type of production, and finally into complete production as a useful article or component of an article. This cycle, from laboratory to production, seems to be getting shorter as time goes on. It took about 50 years for electricity to come into practical use, but now it seems the time span is more like 10 years in going from research to production. Transistors were a laboratory curiosity in 1948 and were the basis of a full-fledged industry a decade later. The feasibility of a nuclear reactor was demonstrated in December 1942, and experiments for the production of useful electrical power were made shortly after the war. But the costs are still too high to justify nuclear power except in special cases. Nevertheless, 20 years after the first chain reaction, power reactors are in use in ships, in submarines, in the Antarctic, and in the United States, Great Britain, and the Soviet Union. To quote the example of one industry which is closely allied with technical developments, DuPont estimates that half their sales and 75 percent of their profits come from products that were in the laboratory 10 years ago.

The never-ending search

Hence I conclude that modern science, since Newton, has discovered a way to explore and understand the secrets of the universe. Because of the innate curiosity of man, science will continue this investigation. Every answered question raises more to be answered, and the search will never end. Closely allied with this scientific development is a technological development which applies the principle and understandings of pure science. Because of the obvious value in the sense of ability to make useful devices, or to grow more and better food, or to control the local environment, the technological development will continue to press hard behind the scientists; the rapidly expanding technology will continue to expand.

Now there are certain aspects of our situation as a result of this development which I should like to discuss.

First, there is the matter of resources. At one time the most important national resource was good agricultural land. Good land, in sufficient amounts, would insure food for the people. Now land is much less important. The efficiency of food production has been greatly raised so that equally important resources are raw materials and energy sources. As a matter of fact, even these resources are becoming of less importance. The most important single resource in the advanced nations of the world today is skilled technical brain power. Highly trained engineers and scientists are necessary if the nation is to keep its standing among other nations. The importance of education in these fields cannot be overestimated.

Technology and the good life

Second, modern technology is able to provide for all reasonable material wants of people all over the world. This is something completely new in the history of mankind. In primitive cultures the labor of all of the people is needed merely to sustain life. As civilization advances, a portion of the society is supported by the productive labor of the others. This portion may be a governing group, priests, soldiers, or rich landowners. Life for most of the members of the society, however, during almost the entire course of history, has been hard and near starvation. Now, however, in principle, technology has shown the way to provide all the members of the society with a reasonably good life. This is true because we have developed our production, both of food and material goods, much more rapidly than our population has grown. Technological advances have made this increase in productivity possible. At the present time there is only a portion of the world in which technology has advanced essentially to this point, but the post-war period has clearly been one in which nations all over the world are striving to enter into this technological era.

Granted that we are living in the midst of an explosive development of science and technology, which is continuing at an accelerated rate and is spreading all over the world, for the obvious reason that it holds the promise of freedom from want, what kinds of problems can we forsee resulting from this development? In other words, if technology can satisfy our material needs, why not utopia?

Technology is reducing the number of man-hours of production labor required to satisfy our needs. Of course, our needs are increasing. The luxuries of yesterday are the necessities of today, and our consumption of raw materials and energy is growing rapidly, but even so, the increase in productivity is so great that we have a problem of surplus plant capacity in many areas. The needs of the service industries and the government utilize a portion of the surplus labor, but the fact remains that there is a great increase in leisure time. This increase in leisure is perhaps the heart of the problem. How can we educate people to be able to use their leisure in a constructive fashion, and by what standards shall we judge whether this leisure is well spent? Western civilization has strongly emphasized the importance of labor and also of thrift. An economy of plenty wants neither. How do we readjust our standards?

For man to live a happy and useful life he must feel in tune with his environment and his fellow man. He must feel that his motivations and ideals are supported by his fellows; otherwise he is an outcast. Because of the rapid evolution of our technological society, much of our social culture has not been able to keep up, and it is better adapted to an earlier time. Therefore, we have the basic difficulty that is simply expressed by a yearning for the "good old days," and is really an admission that the technical world is moving too fast for us. In some cases this leads to serious emotional disturbances or a refusal to face the realities of the modern world. If we look to the future, it would appear that we must learn to evolve our cultural and moral standards more rapidly than in the past, or else find an increasing discontent with a potential utopia. In a word, the problem which must be solved can be stated thus: Given a growing technology, and its ability to provide us with all of our material needs, how can man learn to live with himself and with his fellow man?

Decisions which face humanity

I have posed some problems. Now I would like to consider some of the decisions which face humanity as a result of our developments in science and technology. As I have said, this phase of our cultural evolution appears to be proceeding at an ever increasing rate, and to be far outdistancing our social and biological evolution.

Therefore, we must examine the sorts of decisions which science has made inevitable. First, and most important, is the decision as to whether we want to commit race suicide. Science has given us the tools to do so. We could probably do it tomorrow; we could certainly do it a few years from now. It is not a subject to be dismissed as too improbable or too unthinkable. Even in the animal world some strange things happen to social groups. For example, the lemmings of Scandinavia are reported to march into the sea and drown in enormous numbers for no apparent reason except, possibly, the pressure of population. Likewise, in human history some very strange things seem to happen under the pressure of motivations which appear quite incomprehensible a few years later. An example is the Children's Crusade of the Middle Ages, or even the trench warfare of World War I; neither accomplished any useful purpose. Of course, the whole history of warfare is filled with examples of useless fighting for irrational purposes and prolonged far beyond any conceivable value. Thus we must conclude that man is subject to irrational urges to violent action, and that mass suicide is not out of the question.

The key decision

Since the power to unleash full-scale nuclear warfare is in the hands of a very few individuals, and since the decision can be reached in a matter of seconds, it might seem to be almost impossible to provide assurance that such a decision will not be made. In fact, the situation is potentially even worse because of an increasing tendency to rely very heavily on computers and radars to make the key decision, which leads to the danger of an electronic failure releasing a holocaust.

It is not yet clear how we can reach the decision to make race suicide impossible, but it is clear that there must be an increasing awareness of the necessity for such a decision, and a continuing search for the answer. If we do not find a solution, we are voting "No" by default, and the human race will be fortunate to see the year 2000.

Let us assume that I am too pessimistic and that either the situation is not as fraught with danger as I indicate, or else a real solution is found. What then?

A second vital decision area will face us when the biological sciences have attained the same kind of understanding of the living world that the physical sciences have attained of the inanimate world. Understanding will bring with it the ability to modify or control. Just as we are increasingly faced with the consequences of this ability in the physical world, so too — in a manner which will be of far more direct concern to individuals as human beings — will we have to face some very fundamental issues in the biological world.

Some of these problems are already upon us.

For example, medicine is able to do some remarkable things as a result of understanding disease and the chemical and physical actions of the human body. But, as a result, we are keeping alive an increasing number of people who find great difficulty in living normal happy and useful lives. The fundamental precept of medicine has always been to save life at any cost. As we become more skillful we are able to keep a spark of life in the very old or the very sick, even though they may be living only a sort of vegetable existence. In the future this will be more true. Therefore, the question of the ethical position which a doctor should take towards euthanasia is one byproduct of the development of medicine. Other examples of ethical decisions which have already arisen as a result of advances in biological sciences, include such matters as our attitudes towards birth control and truth serums.

If we look into the future a little way, we can see some remarkable possibilities with the psychological drugs, and, in the genetic area, with controls comparable to what has already been accomplished with domestic animals. Clearly, biological science will require an acceptance and understanding of the extent to which the scientist can be permitted to play at being God with the human body and the human mind. Again, if the decision is not made, we might some day face the misuse of science to an extent as devastating in its effects as the potential of nuclear bombs.

The responsibility of science

A third area of decision-making concerns the authority and responsibility of science. Within recent years the scientist has been given more financial and political authority than he has ever before enjoyed. The estimated expenditures of the federal government for research and development will reach $15 billion in the next fiscal year. In addition, private expenditures may reach $5 billion more. Comparable figures for 1940 are $100 and $300 *million*. Even in 1954 the figures were only $1 and $2½ billion. In the last decade, however, total R & D expenditures have been more than doubling every five years. Although most of this money is spent on applied science or developmental engineering, nevertheless science has control over very large resources.

In the political sense, too, government is increasingly aware of the necessity of inviting scientists into the inner circles of government policy, not only to help understand the significance and utility of the sums of money being spent on research and development, but because science per se has become an important instrument of national policy. Consequently, scientists as responsible citizens have a clear responsibility to conduct their research for the government to the best of their abilities and to be financially responsible in their expenditures of public moneys. Likewise they have a responsibility to advise the government on matters in which they are competent.

I am concerned, however, about another phase of scientific responsibility. As the resources and powers available to science increase, the possibility of performing experiments which have far-reaching or even irreversible effects on our environment increases. At one time, some people were concerned that nuclear experiments might blow up the whole earth. This, of course, is a groundless concern; but the problem of nuclear fallout is not. Fortunately, the scientists involved have indeed been responsible and no serious harm has resulted.

There are other experiments, however, with more subtle results. For example, the widespread use of DDT has caused a significant change in the balance of wildlife in some areas; the recent very-high-altitude nuclear explosion has significantly changed the innermost Van Allen radiation belt.

Dangerous experiments

Probably no experiment has yet resulted in any very harmful unexpected result, but with increasing capabilities the possibilities must increase. Any such experiment, therefore, whether it be in weather control or insect elimination, should not be performed without a public understanding of the consequences. The decisions which have to be made relate to the extent to which the public is willing to allow the scientist to experiment with the environment. I do not believe the consequences of allowing this decision to go by default would be very harmful, because I have a great deal of confidence that scientists will not perform an experiment of this sort without proper analysis. But I do think it is a matter for public debate and understanding if relations between certain scientific groups and the public at large are not to be unduly strained.

Finally, a fourth area where vital understanding and decisions are needed is the broad area of learning how to live in a world which is capable of a technology of plenty. Even though it is possible to produce ample food and material goods, we have not yet solved the problem of distribution — or the problem of developing a successful mode of life for large portions of humanity.

In a biological evolutionary sense, very little separates modern man from Stone Age man. Occasionally, in fact, the more primitive aspects of humanity break out in strange fashions; consider Nazi Germany in the immediate prewar years, for example.

Actually, of course, we live in a world which contains a very wide variety of social cultures, down to the very primitive. Every year modern communications bring the world closer together, so that we have very advanced technological civilization only a few hours away from the most primitive social groups, barely able to sustain life by crude agriculture or hunting. Therefore, it is necessary to develop an understanding of the proper relationships which should exist between various social cultures. Decisions must be made as to how to implement these relationships. In the early days of this country many problems were caused by giving alcohol and firearms to the Indians. Whether this was good or bad is not the point, but, translating this situation into modern terms, we must consider the consequences of disturbing a primitive social culture by suddenly adding some of the gadgets of modern technology.

Some personal views

I started by asking if we were headed for a negative utopia, founded on a scientific dictatorship. I will say, probably not. One reason is that science and technology are moving away from the rigid mechanistic determinism of the late 19th century. At the end of that century the pattern of physics was represented by the mathematical laws of Newton and Maxwell. All actions were the result of applied forces and, given the forces, the actions could be exactly calculated. In other words, if we knew the exact condition of every atom in the universe at a certain instant of time, we could, in principle, compute exactly what would happen at all future time. Along with this determinism was a belief that all the basic laws of the physical world were understood. It seems to me that the orderly scientific dictatorships of Edward Bellamy and H. G. Wells are a consequence of this orderly mechanical physical world.

Science today, however, not only knows a great deal more about the physical world; it has a much more humble attitude towards its knowledge and its lack of knowledge. Furthermore, science has found that at the atomic level the certainty of Newtonian mechanics disappears into the probability functions of quantum mechanics. And, on the very large scale of the astronomical universe, Newtonian mechanics must be replaced with the laws of Einstein. In both cases, the very small and the very big, the behavior of the physical world does not obey the dicta of "common sense."

Coupled with these developments in science are the developments in technology which carry us further into the realm of cybernetics. The more that we make machines automatic, the more we can make them responsive to individuals. Thus, many buildings have room temperature control which you can adjust to suit yourself. The modern automobile with power steering and automatic shifting and all the rest does not require a trained engineer to drive it. The modern telephone allows you to talk to your friend anywhere without invoking messenger boys or switchboard operators.

The important individual

Hence, it appears to me that science and technology together are moving into an area where the individual is becoming increasingly important. He is no longer a cog in a vast machine, and therefore we are moving away from the threat of scientific dictatorship.

We are living in one of the Golden Ages of history. Never before have so many people been able to live the good life. But, regardless of whether there is a scientific dictatorship or not, there is still no guarantee that this Golden Age will last. There is, first of all, the need to keep our present physical powers within bounds and to assure that our future biological knowledge and power is kept under control. There is the need to keep our productivity ahead of our population, and to develop satisfactory means of incorporating modern technology into less advanced culture. Finally, there is the necessity that the cultural evolution of our society should be able to find new ethics, new motivations, new principles appropriate to the dynamics of material and technological developments.

One final thought: Civilization has always seemed to require a governing elite and slaves to provide the elite with food, shelter, clothing and all the other material appurtenances to life. Since the Industrial Revolution, the slaves have been machines. Now the machine is acquiring judgment and perhaps a little intelligence. Our material civilization is so successful because we have so many machines working for us. In the past, many civilizations have fallen because of a revolt of the slaves. Will we ever have to face that problem with our machines?

Man at the threshold of space. Are we at the beginning of a golden era -or can we expect the submergence of all human values? For more than 50 years some writers and think-ers have been concerned about the consequences to humanity of allowing science to run roughshod over all facets of life. From Jules Verne to George Orwell they have painted a grim picture of life under a scientific dictatorship. As one reads these books it is surprising to realize how many of their prophecies have already come to pass and, conse-quently, to wonder if we are inevitably heading for one of these dreary, negativ On the Threshold of Space (aka Threshold of Space) is a 1956 drama directed by Robert D. Webb, starring Guy Madison, Virginia Leith and John Hodiak. It was Hodiak's final film; he died six months before it was released. On the Threshold of Space provides a historical depiction of air force tests made in the United States for the imminent space race. Capt. Jim Hollenbeck (Guy Madison), a dedicated physician assigned to the space branch of the United States Air Force Medical Corps, voluntarily undergoes The space is expansion of the path, it expresses the quality of the public spaces,which arenâ€™t simple vectors but also places to live in.In particular the space take importance inside the landmarks with a green walk discovering the urban agriculture. The threshold marks the limits of the areas: the totems at the urban scale gives the orientation reference in the territory like a bell tower in a square; the landmarks at the intermediary scale works at two different layers: they can be perceived as references upon the highway, seen at the velocity of the cars,or as part of the green path from. b