The Voice of Dr. Wernher von Braun

An Anthology

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– CHAPTER 5 –

COLD WAR PARANOIA & SPUTNIK 1

Never before had so small and so harmless an object created such consternation.
— Daniel J. Boorstein: *The Americans: The Democratic Experience*[32]

Between 1945 and 1989 the United States and the Soviet Union were in an intense political, military, and economic confrontation that came to be known as the Cold War. The struggle between the two superpowers dominated international affairs, and the conflicts it spawned raged across the globe. The world was seemingly divided into two armed camps: the United States and its allies against the Soviet Union and the Communist bloc.

The competition between the two superpowers was played out at many levels, but none was more visible, more consistent, or had greater impact on the United States than the arms race. It was a race driven by fear and fueled by uncertainty; a contest depicted by both sides as a struggle for national survival.

In retrospect, it is difficult to recapture the sense of fear and anxiety that, for many Americans, characterized the early years of the Cold War. From the United States' perspective, the Soviet Union and its communist allies appeared to be on the offensive around the globe. These were the days of the "Red Menace," a time when school children crouched under their desks during air raid drills, worried homeowners built fallout shelters, and the government conducted an intrusive campaign to ferret out shadowy "communist sympathizers" suspected of plotting against the nation.[33]

One of the many shock waves that affected the consciousness of the United States following World War II occurred August 1949 when the Soviet Union successfully exploded a nuclear device, thereby ending the American atomic monopoly. Many Americans jumped to the conclusion that the United States was losing the Cold War.[34] The Big Three alliance of World War II, often strained during the war itself, quickly splintered as the victors began to plan peace. Questions of territorial boundaries, spheres of influence, atomic weaponry, trade, economic reconstruction, political principles, and international organizations divided Britain, the United States, and the Soviet Union. Americans as a rule were resentful of the Marxist/Leninist teachings of Communism. Russia resented the fact that the United States refused to recognize the Soviet regime. Why the Cold War developed with such divisiveness is a topic of spirited debate among scholars. Recent scholarship makes clear that there is no single explanation for the origins of the Cold War.[35] Did Stalin and the Soviets represent a deceitful, dangerous expansionist threat? Or were they mainly motivated by understandable security concerns which prompted them to seek control over a ring of neighbors that had historically been a corridor for invasions? Were their actions manifestations of aggression, or were they reactions to a Western bloc attempting to impose its own influence, while flaunting the bomb on its hip?[36] There was/is a wide-ranging viewpoint that military power goes hand-in-hand with political power.

Aside from the various courses of action being presented by policy makers, probably many consider that the most compelling event was the Soviet launching of *Sputnik I* later in 1957. Not only did the Soviets have nuclear capability, they had the means to launch a possible nuclear warhead great distances.

"Listen now," said the NBC radio network announcer on the night of October 4, 1957, "for the sound that forevermore separates the old from the new." Next came the chirping in the key of A-flat from outer space that the Associated Press called the "deep beep-beep." Emanating from a simple transmitter aboard the Soviet Sputnik satellite, the chirp lasted three-tenths of a second, followed by a three-tenths-of-a second pause ... repeated over and over again.[37] In the history of space flight, there are few events that so affected the public; scientists, academia, engineers, and professionals in general could not believe that the simple, backward Soviets were capable of

surpassing the United States in any field, let alone launching the first artificial "Moon" orbiting the Earth. In Huntsville, von Braun declared, "We could have done it with our Redstone two years ago!"

Air Force General James Gavin recalled to von Braun, prior to the launching of *Sputnik I*, "I had a hard time convincing Congress that launching a satellite was possible. Finally I decided to bring Dr. von Braun before a Senate Committee. I brought you into the hearing room where you began to talk about the Soviet capabilities. After listening awhile, Senator Ellender said that we must be out of our minds, that the Soviets couldn't possibly launch a missile or a satellite. He had just come from a visit to the Soviet Union and, after seeing the ancient automobiles—and very few of them—on the streets, he was convinced that we were entirely wrong. As you listened, you nodded your head, acknowledging what the Senator was saying and I was a bit concerned that the recorder of the hearings might record von Braun's gestures as agreement. So, I handed you a note suggesting that you be careful not to give the impression of agreeing with the Senator, since I knew that neither one of us did agree with him. The Chairman of the Committee brought the hearing to an end and then called me before him and threatened to throw me out of the hearing for attempting to influence a witness. It brought the hearings to an end and no one was convinced that the Soviets could possibly launch a satellite."[38]

On Friday evening, October 4, 1957, some fifty American scientists involved in the celebration of the International Geophysical Year (IGY) were attending a reception given by their Russian counterparts at the Soviet Embassy in Washington, D.C. A few minutes before seven, word arrived that Moscow radio was broadcasting the astonishing news that the Soviet Union had launched the world's first artificial satellite, which it dubbed *Sputnik*. The American scientists were caught completely by surprise. After a moment's consideration, one of the American scientists clapped his hands, asked for everyone's attention and raised his glass to toast the Soviets on their accomplishment, the launch of the first man-made satellite in human history—the true dawn of the space age. How could a backward Communist nation beat the United States into space?[39]

Sergei Korolev, Russia's enigmatic rocket engineer, waited ninety-three minutes before *Sputnik I* had completed its first orbit and ground control could confirm that it was indeed overhead, beeping. Then he phoned Khrushchev at the Kremlin. No one could have anticipated the media riot that followed *Sputnik* in the West. The panic was further exacerbated when details about the man who had orchestrated this magnificent celestial maneuver remained cloaked in secrecy. The West was only informed that the man behind *Sputnik* was known as the Chief Designer. While it jolted the rest of the world, the successful launch received casual treatment, in Moscow. Nikita Krushchev never dreamed it would have so powerful an effect. He called it "just another Korolev rocket launch."[40]

President Eisenhower's White House tried to minimize the significance of the *Sputnik* launch. He left for a weekend of golf at Gettysburg. Press Secretary, James Hagerty, and Secretary of State, John Foster Dulles, stated the *Sputnik* "was no surprise" and that the President was being kept informed.[41]

Michigan Governor, G. Mennon Williams, waxed poetic:

Oh little Sputnik flying high
With made-in-Moscow beep,
You tell the world it's a Commie sky
and Uncle Sam's asleep
You say on fairway and on rough
The Kremlin knows it all,
We hope our golfer knows enough
To get us on the ball.[42]

Senate Majority Leader, Lyndon Johnson, said the Eisenhower administration had made one of the most monumental political and foreign policy blunders in the history of the nation. *Sputnik*, Johnson reminded America, represented the high ground, mastery of the heavens. Maybe it was all right with others in government, he told reporters, but he for one didn't care to go to bed by the light of a Communist Moon.[43]

Senator Richard Russell, chairman of the Senate Armed Services Committee, said the Soviet satellite was "proof of growing Communist superiority in the all-important missile field. We now know beyond a doubt that the Russians have the ultimate weapon—a long-range missile capable of delivering atomic and hydrogen explosives across continents and oceans."[44]

James R. Killian, president of MIT and soon to become White House Science Advisor, wrote that *Sputnik* caused a "crisis of confidence" among the American people. The conservative *U.S. News & World Report* likened *Sputnik* to "the first splitting of the atom." Edward Teller, the "father of the H-bomb," told a television audience that the United States had lost "a battle more important and greater than Pearl Harbor."[45]

Fortunately for mankind, only the smaller missiles developed in the Cold War years have been fired in anger. The warheads of the hundreds of long-range missiles that stood poised in the United States and the Soviet Union could have killed hundreds of millions of people and destroyed a large percentage of the world's industry if they had ever been used. The tenuousness of the balance of power that prevented their use was shown in 1962, when the Soviets began setting up offensive ballistic missiles in Cuba. The world came close to nuclear holocaust in the confrontation between President John F. Kennedy and Premier Nikita S. Khrushchev in October 1962. There are still no guarantees that the holocaust will not be triggered by some confrontation in the future.[46]

Wernher von Braun was aware of the threat of living under a dictatorship, as was the plight he feared for the citizens of the Soviet Union. Von Braun knew the future for a world at peace was through dominating the space program. Unfortunately for him, the threat to the world by Stalin was not apparent until the Soviets launched *Sputnik*. Having lived under a ruthless dictator, the knowledge that the Soviets were working on missiles was of great concern to von Braun. He recognized in the Soviet regime the similarities with life under the Nazi dictator, Hitler.

In 1952, and the following thirteen years, his speeches reflected what he felt would be the fate of the United States and the rest of the world if the politicians and citizens did not become aware of the necessity for "Space Superiority" by the Free World.

Von Braun presented the following talk to the Business Advisory Council for the Department of Commerce in Washington, DC on September 17, 1952.

Space Superiority as a Means for Achieving World Peace[47]

THE MOST DISTINGUISHED MILITARY THINKING OF OUR TIME CONCEDES THAT THE only way to win a third World War is to prevent its outbreak.

The statesmen of our country have made every conceivable effort to ease the tensions arising from the dislocation of the balance of power which followed World War II, but their labors at the conference table continue to be bitterly disappointing. The net result of all the talk is a very expensive realization that there is only one way in which a treaty with the dictators of the East can be made to stick: namely to back it up with enough force to compel its observance.

Thus the West finds itself obliged to arm to the teeth in the interest of maintaining an uneasy peace in this tortured world and the United States bears the major brunt. In rearming ourselves we face a double problem. The first is to create a *deterrent power* which shall be sufficiently effective to inhibit the East from continuing its aggressive expansion ending in all-out war. Secondly, we must build up *fighting power* so that we may have the best prospects for success—and minimum destruction in our own and allied countries—if global war cannot be avoided. In the light of the introductory statement—credited to General Marshall—that to prevent such a war is to win it, it is only logical for the United States to give first priority and immediate, maximum attention to creating and making effective *deterrent power*.

At the present time our deterrent power depends upon the combination of atom bombs and strategic bombers of long ago. There is, however, considerable uncertainty as to just how much longer that combination will remain effective. The mere possession of atom bombs by the Red rulers

will not render Red nerve centers and nerves less vulnerable to our bombs, but the question is whether our global bombers will be able to reach their targets when the time comes, if come it does.

But a short two years ago it was almost the consensus of opinion of engineer and military alike that certain large intercontinental bombers were immune to any and all attacks. Since that time, the Russians have not only developed, but put into mass production interceptors with a much higher ceiling and a top speed much greater than those bombers. Of course we have transonic bombers in the works, but nobody questions today that by the time we get them, the Russians will be all ready with supersonic interceptors. We also know that the Soviets are vying with us and other Western Nations in the development of new and effective ground-to-air guided missiles which could make the life in a heavy bomber crew anything but a bed of roses.

The atom bomber may have been the "ultimate weapon" heretofore, but this will not be the case much longer. Like the battleship, the atom bomber will become just another weapon, capable indeed of playing an effective role in war, but its deterrent power is on the decline. The handwriting is on the wall.

Winston Churchill thinks that the uneasy peace the world has enjoyed since 1945 has been due to the deterrent power exercised by strategic bombers with their capacity for delivering atom bombs anywhere they might be needed. It was this country's statesmen, her industrialists, her engineers, her designers, her scientists, her workmen, her airmen who had the vision, the industry and the initiative to bring that deterrent to a third World War into being. I might include the taxpayer, without whose contribution the enormous financial requirements of the Strategic Bomber concept and the Atomic Program could not have been met.

It is now the time, however, when we must familiarize ourselves with the thought that strategic bombing will soon be relegated to a secondary position, to the status of the battleship, so to speak. We must seek a new "ultimate weapon" which will preferably not only return to us that deciding "edge" we once had over Red aggression, but likewise be kinder to the taxpayer and be able to contribute something constructive to the world whose uneasy armistice we hope it will successfully transmute into permanent peace.

Rocketry is, I believe, capable of solving the world's peace problems more effectively than any other branch of science and engineering, and simultaneously—that is to say without additional expenditure—doing a great deal of advancement for mankind. The first nation to launch a rocket ship that is able to carry a crew out beyond the stratosphere, will posses what may well be the long-sought "ultimate weapon." But beyond that, and once it has fully exerted its deterrent effect upon would-be aggressors, it will be capable of serving an infinitude of scientific—that is to say, humanitarian—ends.

Ladies and Gentlemen: I want to appeal to you for your support of an orderly coordinated space program in this country. Such a program will require some few millions of dollars for studies to be carried on during its first phases, but the investment will be repaid a hundred times over when we reach the "hardware stage," and conditions will force us to accelerate that stage, mark my words! We've got mighty little time to lose, for we know that the Soviets are thinking along the same lines. If we do not wish them to wrest the control of space from us, it's time, and high time we acted!

*** END ***

– Chapter 16 –

LADIES AND GENTLEMEN OF THE MINNESOTA EDUCATION ASSOCIATION: [59]

I am a little uncertain as to how to approach this assignment. Judging by my personal mail, coming from all parts of the country, from boys and girls in elementary schools, high schools and colleges, our young people seem to know more about rockets and space vehicles than do the designers and developers of the Army's missile team!

They send me designs for ships to reach the Moon and other worlds. One boy even sent a sample of his solid propellant rocket fuel—and the material was so sensitive that it might easily have ignited anywhere along the route in Uncle Sam's mail system. By comparison, we fellows are still driving Model T Fords, while the youngsters are well on their way to building the solid gold Cadillac of the Space Age.

Sometimes I feel my daughters, after hearing their classmates talk, and seeing some of the latest fictional wonders in the movies or on television, must regard their old man as a back number!

So, with some trepidation, I will try to talk a little about space travel, asking you to remember that the problems and factors we must reckon with are a little more difficult to resolve outside the classroom.

As one who has espoused the cause of space travel for a long time, sometimes under rather trying circumstances—as when the Gestapo clapped me into a Nazi jail for talking about it—I would like to say that the enthusiastic reception it has received in America's schools has been most encouraging.

In spite of the seeming interest in the exploration of outer space, the program still requires salesmen. But the need is for salesmen who have some sense of responsibility, who know what they are talking about, and who are sincerely interested in the nation's best interest—not their immediate financial gain. This space business recalls a comment by Edward Carpenter which can stand repetition: "Every new movement or manifestation of human activity, when unfamiliar to people's minds, is sure to be misrepresented and misunderstood."

I suppose I have been asked a thousand times, "why should we explore space?" or "why do you want to go to the Moon?" Answering the second question first, I don't expect to be on the first space ship that reaches the Moon. If it turned out to be one of Mr. Khrushchev's vehicles, I am sure there would be no room for me. If it is one of ours, they will take a long look at me and say, "Pshaw—you are too old!" But I do expect, and I am looking forward, to getting there when travel between Earth and Moon has been stabilized and the ICC, or whatever passes for it in the Space Age, has established the usual tariffs!

As to the why of space travel, I would point out that the events of the last eighteen months or so have given us an even more valid reason. The Sputniks and the Luniks were convincing proof of the dynamic, large-scale effort which Soviet Russia is making to advance the development of rocketry for eventual space travel. They amply demonstrate that the Russians consider space travel as something more than a new area for scientific investigation. The Communists are keenly interested in the possibility of extending the already large sphere of political influence, and increasing their prestige and their military strength.

It is undeniably true that the Soviet achievements in satellite and space technology have heavily influenced world opinion concerning the Russian military, scientific and industrial potentials. Certainly they have profoundly affected the attitude of those smaller nations which must rely upon the major powers for military or economic support.

Consequently, I firmly believe that an active space program of major proportions has become a "must" for America and the western world, for we must check any further expansion of Russian influence in order to safeguard our way of life.

In the Age of Technology, into which science and engineering have transported us, it is extremely difficult to separate military and political considerations. The same ballistic missiles that launch satellites and scientific missions can be equipped with atomic warheads for purposes of aggression and conquest. Further, we must recognize the threat posed by the military exploitation of space ships and satellites by aggressors. If only for the requirements of national defense, we must support an all-out effort to achieve a maximum capability.

I do not wish to convey the impression that only political and military considerations enter into the concept of space travel. Expanding our knowledge of the spatial environment will enrich our understanding of the universe of which we are but a tiny part.

I can illustrate this by referring to the data obtained by some of our space exploration projects. The Explorer satellites launched by the Army in 1958 have returned valuable measurements of space phenomena. They provided exact information about the existence of a hitherto unknown radiation belt surrounding Earth. They confirmed the correctness of our computations regarding orbital data. They indicated the frequency of micrometeorite impacts. They furnished temperature recordings from which we deduced that it will be possible, without too much effort, to maintain a range within an orbital vehicle acceptable to human beings.

Our *Pioneer IV* space probe, likewise launched with the assistance of the Jet Propulsion Laboratory (JPL) of the National Aeronautic and Space Administration (NASA), became the first made-in-the-USA satellite of the Sun. With this firing, we demonstrated the capability to achieve escape velocity of more than 24,000 miles per hour. Radio contact was maintained with the probe over a range of more than 400,000 miles, using miniature transmitters with an input of a fraction of a watt, and enabled us to gather additional data of great value for future tests.

Of course there is much interest in the possibility of economic returns from the large investments required to carry out significant space flights. While the present state of the art is relatively immature, we can look forward confidently to a number of highly useful applications.

For example, an orbital vehicle can be utilized for continuous surveillance of Earth's total cloud cover. It could alert threatened areas to imminent storms. The data accumulated by this "all-seeing" weather eye could provide the basis for the most efficient weather forecasting service mankind has ever had available. If you think about the immense damage inflicted by storms annually, the loss of lives and property, any reduction in the toll would be very worthwhile. The entire world could benefit from a global weather forecasting and warning service that might well be undertaken as an international program.

We are currently engaged in developing the Saturn multi-stage space rocket system for the Advanced Research Projects Agency (ARPA) of the Defense Department (DOD). The first stage of this huge rocket will generate about 1,500,000 pounds of thrust, or five times more than our present ICBMs. With that kind of power it would be possible to place really big satellites, on the order of 15-20 tons, in practically permanent orbit. Suitably instrumented for communications purposes, a number of satellites could improve international transmissions markedly. Presently, transoceanic radio communication is often impeded and interrupted by atmospheric disturbances. Also, the existing undersea cables are subject to rupturing and their capacity is approaching the saturation point.

The transmission of television signals from one continent to another has been accomplished only with considerable difficulty. One of the most serious limitations is that high frequency waves proceed only in straight lines and will not bend effectively around the Earth.

It is possible, by positioning a satellite at an altitude of 22,300 miles, to have it remain stationary in essence relative to a point on the Earth's surface. For orbiters a few hundred miles above the Earth, such as the Explorers, the period of revolution is on the order of an hour and a half to two hours. For a satellite at that distance of the Moon the orbits period is 28 days. At the 22,300 miles altitude, the period will be 24 hours, which means the satellite would revolve at the same speed at which the Earth rotates on its axis. Three such satellites, going around in the equatorial plane and spaced 120 degrees apart as they circled through the same orbit, could

provide a permanent system of relay stations for high frequency radio and television communication.

Since every point on Earth will always be in line-of-sight contact with one of the three orbiters, and since each satellite can always see the other two, they would enable us to provide the Earth with an uninterrupted communications link for worldwide telephone, telegraph, radio broadcasting and television service. The Saturn system can make this service possible.

Another potential economic application of space vehicles is an aid to navigation. Employing standard equipment, a navigator can, by stellar observation, locate the position of a ship at sea within about one mile. By the same procedure, an aircraft can be located within a possible error of five miles. If the stars become invisible because of overcast, these methods are useless. But with a satellite sending out a continuous radio signal, or which transmitted when queried by ship or plane, it would be possible to locate either ship or aircraft within a margin of a few feet.

The opportunity for unobstructed surveillance of the Earth from either satellites or space stations offers obvious military advantages, as well as benefits in the scientific and economic areas. It would help to improve the cartography of the Earth and to complete geodetic surveys. The exact location and dimensions of the continents could be defined with greater accuracy. Eventually we could register the continuous changes that are taking place on Earth's surface.

Space travel will, of course, offer unlimited opportunities for scientific research, the total results of which are beyond the bounds of our imaginations. The discovery of the Van Allen Radiation Belt was a most promising start. Future satellites, manned and unmanned, will further explore the mysteries of cosmic radiation, which may be the principle cause for mutations in the plant and animal kingdoms, although only the products of their collision with molecules of the atmosphere really impact the Earth.

We must learn more about the radiation emitted by the Sun. It is the mainspring of every form of life on this planet, but only a small portion of it passes through the filter of our atmosphere. Telescopes carried in artificial satellites will permit astronomic observations without atmospheric interference. Unmanned observation satellites will help to prepare for the launchings of space vehicles to the Moon and Mars.

Finally, we need to study the effects of the space environment on man himself, in order to prepare him for voyages into deeper space, for his coming visits to the Moon and the nearer planets. From these explorations we shall gain new knowledge about the history of our planetary system and the development of life—perhaps in its most primitive form.

NASA has embarked upon Project Mercury with the objective of placing man in orbit in a capsule. We are contributing to this program. Several Army Redstone missiles will be launched to test out the capsule separation and recovery systems. Finally, we shall give one of the astronauts a ride in a ballistic missile during which he will soar far beyond the atmosphere and travel across a part of the Atlantic Missile Range to descend into the ocean. From these experiments will come highly useful data preparatory to space travel.

Sometimes we hear complaints that there are many problems to be solved of vital interest to mankind and that they ought to be taken up before we busy ourselves with space exploration. I believe the United States is big enough to do both without harm to either. Whether some nations not yet engaged in space programs might wish to join in the effort is a question which may, to a certain degree, influence the pace of our progress. It will not, however, alter the natural course of space development.

Man employed ships to discover new continents. He used airplanes to conquer heights never previously attained. He will also take advantage of the possibilities inherent in rocket propulsion to use space vehicles to probe the unknown regions beyond Earth's atmosphere. Curiosity alone is sufficient motivation, even if much more is required to muster the necessary resources.

It should be apparent that in addition to designing and building space transportation systems, much of what we accomplish will depend upon the contributions of the medical profession. Pooling the knowledge and skills of the doctor and the engineer, we can create the artificial environment needed to ensure man's survival in the vacuum of outer space.

The deeper we penetrate into this new environment, the more we learn about it, the less often will anyone ask "why travel in space?" People will come to realize that extending our knowledge of the Universe is as natural and inevitable as the hazardous expeditions undertaken by explorers like de Gama and Columbus, or the tabulation of the natural elements. Judging from the rapidity with which space travel development has moved from the realm of science fiction into the disciplines of exact science and technology, I am confident that we shall move forward at a rate which may surpass our boldest expectations.

We cannot evaluate tomorrow's possibilities and requirements fully in the light of what we know today. But there is no doubt that the scientific exploration of unsolved phenomena through space flight will be a fascinating and challenging undertaking. It is man's greatest adventure and his biggest opportunity to contribute to world understanding and peace.

Let me conclude by stating one more commonly heard question—I might call it the $64 question, if you will permit another reference to the television industry. Will we overtake the Russians? I think we will, but must qualify that answer by asking another question—how and when?

I have given you my personal views on the Soviet intentions, which are no different, basically, than are their objectives in all other activities—to exploit space for Communism. This is not simply a race between competing teams of rocket designers. It is a deadly competition to achieve a position of dominance: we are motivated, as always, by a desire for peace and knowledge; they are motivated by a dream of empire as old as the Czars and Caesars.

I submit that the Russians have plainly evidenced what they are up to; they began an immense and well-organized rocket development program many years ago. They are, as it were, trying to leapfrog our advantage in aircraft by concentrating on missiles. They have power plants bigger than anything currently available to us, simply because they set their sights on space before we did. The American people must realize that you don't create something like the huge Saturn rocket overnight; it takes time, money, and a great deal of human experience and skill. Meanwhile, the Soviets are not standing still. They have built up an impressive momentum and they have no intention of allowing us to catch up and surpass them if they can beat us to the punch.

We are in a race for which the stakes are as big as space itself and I suggest we must spit on our hands, haul in our belts and get to work in earnest! The consequences of anything less are too awful to imagine—human freedom, human progress is the stake.

*** END ***

– CHAPTER 18 –

DOING SCIENCE

All our science, measured against reality,
is primitive and childlike—and yet it is
the most precious thing we have
— Albert Einstein (1879-1955)

Every aspect of Nature reveals a deep mystery and touches our sense of wonder and awe. Those afraid of the universe as it really is, those who pretend to nonexistent knowledge and envision a cosmos centered on human beings, will prefer the fleeting comforts of superstition. They avoid rather than confront the world. But those with the courage to explore the weave and structure of the cosmos, even where it differs profoundly from their wishes and prejudices, will penetrate its deepest mysteries.

There is no other species on Earth that does science. It is, so far, entirely a human invention, evolved by natural selection in the cerebral cortex, for one simple reason: it works. We must understand the cosmos as it is and not confuse how it is with how we wish it to be.[64]

Kepler and Newton represent a critical transition in human history, the discovery that fairly simple mathematical laws pervade all of nature; that the same rules apply on Earth as in the skies; and that there is a resonance between the way we think and the way the world works. Our modern global civilization, our view of the world and our present exploration of the universe are profoundly indebted to their insights.[65] In the following speech to the American Rocket Society, von Braun reaffirms Sagan and other scientists writings.

On Wednesday, June 7, 1961, a luncheon was held at the Biltmore Hotel in New York City, by the American Rocket Society, Inc., where Dr. von Braun was the guest speaker. Mayor Robert Wagner introduced von Braun. Dr. G. Edward Pendray, founder of the American Rocket Society, was the toastmaster. Distinguished guests on the dais were Mrs. Robert Goddard, Harry Guggenheim, General John Medaris, Dr. Richard Porter and Dr. Detlev Bronk.

Following are the remarks made by von Braun at the luncheon:[66]

SINCE OCTOBER 1957 WE HAVE FOUND OURSELVES IN A RACE FOR SPACE WITH THE Russians, whether we like it or not.

We are in a race for new insights, scientific insights in the mystery of the world surrounding our Earth and our atmosphere, and it is also a race for our military stature in this new environment. We should never forget that space, after all, is not a program but a place, and all these arguments about whether space has scientific significance only, or whether there is a future for the military in space, is rather meaningless in my opinion. It has never been possible to rule out altogether a space in which weapons can travel for military purposes. Right now, ICBMs, IRBMs and anti-missile missiles are traveling freely in outer space, so it would be rather ridiculous to say that space has no military significance.

On the other hand, we cannot possibly say that the United States today would be in mortal danger if we didn't occupy the Moon tomorrow. The Moon may become a militarily important objective ten or fifteen years from now, but today it most certainly is not. *Sputnik I*, which introduced us to this space race, came to most Americans as a shock, and there was a period of breast beating and questioning about what had gone wrong. We asked ourselves if our educational system was to blame for this; whether our scientists were inferior to Russian scientists; and even the moral fiber of our free society came into questioning. Belatedly, we finally embarked upon a space program of our own. We started out humbly enough. Our first satellite, *Explorer I*, weighed a mere eighteen pounds, compared to the several hundred pounds of its Russian counterpart. But

in the meantime, our national space program—or rather its portion devoted for scientific explorations—has grown into a one-billion dollar a year program. I think this is an absolutely unprecedented phenomena; a national program, supported by taxpayers' money, which is not aimed at the production of consumer goods like automobiles and washing machines, or which is not aimed for any other commercial objectives; which has no immediate military significance; and yet, the taxpayer is expected to support it to the tune of a billion dollars a year.

Why do we have to support such a space program? I think the answer is that it is necessary to keep the machinery of our technological and scientific progress moving. I think in the last analysis what makes this machinery tick is very simple. *We have to continue to satisfy our curiosity. I think it is that simple.* Let me quote a few examples of how the desire on the part of a few people to satisfy their scientific curiosity has moved the world. Approximately twenty-five years ago, two Americans, astronomers or astrophysicists, I should say, became interested in the question of what prevented the Sun from burning itself out. They had calculated that under the terrific radiation energy losses the Sun was subjected to every day, every year, every decade, every century, the Sun should have cooled down to a dim, dark red in the many hundreds million years we know it existed; so they asked themselves: "what keeps the Sun hot? What mysterious mechanism is at work to furnish the Sun continuously with new energy?" They analyzed the solar spectrum and finally discovered that under certain conditions of temperature and pressure two hydrogen atoms could fuse into one helium atom, thereby releasing tremendous amounts of energy. Thus, thermonuclear fusion was discovered. Twenty-five years later, man succeeded in duplicating thermonuclear fusion on Earth. And when he did so, he succeeded in a very dramatic way. A little island atoll in the Pacific where the first hydrogen bomb was exploded vanished from the scene forever. Today, thousands of engineers and scientists are busy trying to harness this very same thermonuclear energy for power conversion. Their objective is to produce electricity from thermonuclear energy, and I am convinced that most of you in this room will still see the day when that dream will become reality. When we will be able to make the kilowatt hour for perhaps one-tenth to one-hundredth of what it costs today with abundant thermal nuclear power. Here you see the cycle closed—the cycle of scientific and technological progress. Two astrophysicists being curious about what keeps the Sun hot, the discovery leading to the most terrifying weapon ever invented. But in the wake of all this will be a bonanza for mankind—millions of electrical slaves for everybody.

Many, many other examples could be quoted. It was because an obscure Austrian monk by the name of Mendel became curious about the laws that govern heredity that the famous Mendelian Laws were discovered. Mendel experimented in his monastery garden in Austria with white and black peas, and he wanted to know the laws that govern propagation. The Mendelian Laws have now, a hundred years later, become the ground rule for all our efforts in growing sturdier and hardier cattle, and help us feed untold millions. It was because, sixty years ago, a physicist by the name of Roentgen became interested in the laws which governed the flow of electricity through as vacuum that x-rays were discovered. He had a little glass jar evacuated and ran his currents through the jar. Suddenly he discovered that in his blacked-out laboratory a plate in the corner of the laboratory room glowed every time he turned on the current. Some mysterious rays were apparently traveling between his glass jar and that plate. He placed all kinds of obstacles in the path of these mysterious rays and couldn't stop them. Finally he put his hand in the path and he saw the outline of his own bone structure portrayed against the plate. Thus one of the most powerful tools of medical science, both in diagnosis and therapy, was created. It was because a Britisher became interested in what happened to normal mold that penicillin was discovered, which in the meantime has saved millions of lives. What can we learn from all these examples? I think we can learn two things. One is that it pays off to satisfy your curiosity. The other is that it is impossible to predict what will follow in the wake of amazing discovery.

When Columbus took off on his immortal voyage, the purpose of the exercise was to improve trade relations with China. That problem has not been solved to this very day. But you will probably agree that Columbus did the right thing if you just look at the byproducts. Speaking of outer space, there are so many people today who ask this very same question. Why do we do all this? Why do we spend billions of dollars a year to satisfy our curiosity? Will we ever make the

money? The honest answer is we do not know, but we can prove from past experience that it pays to satisfy our curiosity.

For the first time in human history, we now have the tools at our disposal to explore the world beyond the atmosphere. We have the powerful rockets to do it. We should put them to use. And that is my simple answer to the question a little old lady asked, "Why do we have to go to the Moon? Why don't people stay at home and watch television as the good Lord intended?"

I read with interest recently a column in the *New York Times* entitled "Space and Serendipity." Serendipity, I find, means the discovering of valuable or agreeable things not sought for. Serendipity, then, is one of the bonus results of all research, including space exploration. The value of research is always realized in the wake of discovery.

Another question that many people ask today is, "are we ahead of the Russians?" I think this was a good question two or three years ago. I think it is no longer a good question. Both the American and Russian space programs have developed into many different areas. It has become a very versatile field, and any sweeping generalizations to the effect that we are ahead, or they are ahead, have become rather meaningless. I think the true answer is, we are ahead in some fields and they are ahead in others. Let me be a little more specific. Let's take a look at the score.

I think we have fired more satellites and more space probes than the Russians. We have made the first successful attempts in radioing back to the Earth television pictures of the Earth's cloud structure in our TIROS project. This is a determined attempt to put satellites into use for better weather prediction. We were the first to demonstrate the feasibility of satellite repeaters, active and passive, for communication purposes over long distances. Our *Pioneer V* probe was the first to demonstrate the feasibility of interplanetary radio contact. Radio contact with *Pioneer V* ceased when this probe was twenty-two million miles away from Earth. We were the first to demonstrate successful recoveries from orbital flight with our Discoverer series, vehicles boosted by Thor/Able rockets. We were the first, I think, to demonstrate successful reentry tests with animals—our Able/Baker monkeys, which were fired 1600 miles down the Atlantic about two years ago. We at least published a demonstration to that effect. And finally, our rockets found the Van Allen Belt, this mysterious belt of trapped radiation which surrounds the Earth, and whose very existence was not even known three years ago, but which seems to be a deciding link [in] the action between solar radiation and many phenomenon such as radio propagation taking place on Earth.

On the other side of the ledger, the Russians have most certainly fired larger and heavier satellites and space probes than we. In their last attempt, *Sputnik VII*, which went into orbit a few days ago, was probably the most impressive demonstration along those lines. The Russians were the first to put any object into orbit with their *Sputnik I*. The Russians were the first to place animals in orbit and monitor their survival and behavior under their environmental conditions over an extended period of time. These animals were not retrieved, however. The Russians were the first to fire past the Moon into free planetary space with their *Lunik I*. They were the first to hit the surface of the Moon with their *Lunik II*. They were also the first to photograph the far side of the Moon, a trick that we have not succeeded in yet, although we have tried several times. We have all the indications that the Russians have also succeeded in recovering objects from orbits, and we know that they have a man-in-space program which is at least as aggressive as ours. And I can add to all this that the Russian space scientists that I have personally met in various international meetings impressed me as competent, dedicated and determined men. They are determined most certainly in the sense that they did not want to fall back in this decisive race with the United States for supremacy in outer space. The only area in which the Russians have a significant lead in the space program is in the area of large boosters. They have consistently lofted heavier payloads into orbit and into outer space than have we. Our shortcomings in this direction are my business as Director of the George C. Marshall Space Flight Center.

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