



WE NEED MORE PIEFS

Jerome Wiesner

Massachusetts Institute of Technology

After all the interesting discussions you have had about exciting experiments and challenging new machines, and the interplay between theorists and experimenters, I am going to talk about a field in which the theorists dominate, nuclear war. There may be a lot of machines, but the experiments you would have to do to confirm the foolish theories about winning nuclear wars are not experiments we are particularly interested to encourage. Incidentally, Dr. Press this morning said we do not make high-quality products anymore. He forgot that we make very good military machines. We may make the world's poorest televisions and automobiles, but we make the highest quality airplanes and rockets and nuclear bombs that you can buy. And I believe that there is really some coupling between these two. Who wants to work on a television set when there are laser beams to be developed?

It is a mixed delight to be here today; sort of a bitter-sweet occasion. I am certain that we all welcome the opportunity to remind ourselves about how special Pief is to all of us, to say "thank you" to him and his family, and the rest of you have been doing just that. It is my task to tell him to tell him what we expect from him in the future and to give you some explanation why I think I have a priority over that 2TeV machine, aside from the fact he might be a man who can get the money for it.

We are really here because as a society we pay too much attention to the

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calendar which only marks solar time and ignores biological time. And it tells us that the moment has come for a shifting of the guard. That is not altogether a bad idea. I am sure Pief and his family think it is an extremely good idea. There is generally virtue in passing around the opportunities and especially here in freeing Pief for new challenges that all of us are defining for him. Sid started this morning, and we just heard some more from Burt, and I, at least by implication, am going to tell him what I think he should be doing.

It is a little hard for me to think of a SLAC without Pief, and I suspect this is even more the case for those of you who have had a continuing relationship to the laboratory than for us who admire it and its effective operation from a distance. We meet, as I said, to thank Pief for his many contributions to science, to technology and the survival of the world in the nuclear age, and especially for being such a well-wearing friend. It is really not my place to say anything about SLAC's or Pief's physics. You have already heard a lot about it, and many others are much better qualified to do that than I am.

I am here primarily to talk about the arms race, and Sid has already documented Pief's monumental efforts in this direction. Pief has probably done more than any single individual, more consistently, more clear-headedly, and more firmly. Like Pief and some of his colleagues here at Stanford, I feel like the man who dragged those coals to Newcastle. What your colleagues here have done, and what we all can do and must do is my subject. What we must do is to keep those people in the United States—those misguided people who think that nuclear wars can be fun—from destroying civilization, if not just bankrupting it, in providing what they think is in the interest of national security.

Now that a single high energy experiment may take half a lifetime (of an individual that is, not a particle) and two lifetimes may become the time for building a machine, maybe it is essential that experimenters, if not theorists, have something important to do while waiting for Congressional appropriations for machines, experiments to be approved and built, data to be analyzed, and the next experiment to be conceived. What better than facing the second most intractable problem to a unified field theory, probably a more long-lasting problem, the arms race? This is certainly an effective way to keep yourself in good intellectual condition. When we created the Arms Control and Disarmament Agency in 1961, Leo Szilard predicted this situation. He told me that we should run an ad for secretaries saying that the pay was not very good but the employment would be steady. Of course, he was not counting on the Reagan Administration which has canned most of those people so that they will not have to hear about arms reduction.

For more than 25 years, Pief has spent a substantial share of his time, most of his spare time I think, in efforts to halt the arms race using his scientific ability and his rare common sense, assisting the government, including President Eisenhower and President Kennedy, to seek agreements to halt the spread of nuclear weapons and weapon systems. He has also been an important member of that unincorporated, but worldwide nongovernmental brotherhood of scientists and laymen, sometimes called the "peaceniks," sometimes called much worse, who have been trying for almost three decades to halt what the author Barbara Tuchman in her most recent book has called the "march of folly"—the nuclear weapons race whose most likely 'finis' will be the destruction of civilization.

I, too, have long been a member of that group, first becoming involved as I

think Pief did while serving as a member of the technical groups assembled by the President's Science Advisory Committee in the early or mid-1950s to help President Eisenhower in his efforts to negotiate an agreement with the Soviet leader, Khrushchev, to halt the testing of nuclear weapons and reduce the danger of surprise attack. Those experiences marked a transition for many of us from weapons inventors and builders to a new and relatively frustrating "Horatio at the bridge"-like career, attempting to stem the multimillion man, multibillion dollar Soviet-American arms race.

We got involved because President Eisenhower asked us to. I remember, and I suspect Pief does too, how while we were reporting to him on a study about defenses against a Soviet surprise attack, he suddenly turned on us and said "You can't have that war! There aren't enough bulldozers to scrape the bodies off the streets if you do." And after some more profane observations of the same sort, he shouted "You fellows are working on the wrong problem." He forgot that he had asked us to work on it, or at least we convinced him that it was the wrong problem with our answers. He said "Why don't you help me to try to stop this insane race. Nobody in the government wants to help. Nobody really wants to help me. The Defense Department doesn't, the AEC doesn't, nobody does!"

We explained, as I said, that he had asked for the study but that we were willing to do anything he wanted us to, and he repeated again that we were working on the wrong problem, and we agreed to form a PSAC panel on disarmament. We were not afraid of that word in those innocent days. But we soon learned that our competitors, the militarists who could club us with that word by attacking us for wanting to disarm the United States, always did. They always choose to interpret any call for disarmament—by which we meant stopping making more

weapons, or getting rid of a few, or doing something to slow down the arms race—they choose to regard it as a call for unilateral disarmament. And to this day, I find that if I talk to a less sensible audience than this one, and I happen, in the course of that talk to say I believe in disarmament, somebody will ask me how I intend we defend ourselves after we get rid of all weapons. So we soon found ourselves talking about arms control in self-defense. But we have lost that word too, because it is now being used to rationalize building more weapons. If it could be proved that doing so would make the world a safer place, I am sure we would be for it.

At the time of my own retirement four years ago, Sid Drell challenged me to reinvolve myself in the arms control effort, and I have been doing just that with a great deal of personal satisfaction, if not much success. So while I realize that the local trauma involved in connection with Pief's retirement as Director is worrying you now, it is important to realize that he will be able to spend 200% of his time trying to halt, or at least slow down, the arms race.

In these earlier remarks, I think I have drawn a distinction between Pief's two worlds of SLAC and arms control. Actually his work on arms control played a greater role in the realization of his dream to build SLAC than Pief himself probably realizes. In fact, I asked him about it last night, and he elaborated on the story.

When John Kennedy became President of the United States in 1961, he decided to retain Eisenhower's Science Advisory Committee. Eisenhower had never asked about political allegiance of any of the members, and I suggested to Kennedy we not do it, and he said if it was good enough for Ike it was good

enough for him.

He also retained the Eisenhower special panel working on nuclear test ban negotiations. And one of that group, one of the most important members, was Pief. And so, somewhat later, when the so-called experts in the Bureau of the Budget were arguing against funding SLAC—they had nothing against physics or SLAC or even Pief, this was just their normal reaction to anything that was expensive and long-range—it looked as though they might succeed in killing it until the President learned that Pief was its principal advocate, and then the President became its strongest supporter.

I do not know what moral you can draw from this story unless it is "virtue is its own reward." But I told this story to Pief last night, and he said "Yeah." But that he made the mistake right after it was approved by the executive branch of the government of making an anti-nuclear test speech somewhere and the joint committee in the Congress chiseled a few million dollars out of the program just to show him who was boss.

I am sure I do not have to explain the title of this talk, but I will anyway to emphasize my point. The message I want to leave with you today is that the anti-war movement is overwhelmingly outnumbered and outfinanced everywhere. Those of us who have been spending our time trying to bring a bit of sanity to the arms race, as Pief and many others here at Stanford have been doing, have always been in the minority both in the government and on the outside. Within the government, the only agency that exists for understanding and advocating alternatives to the arms race is the Arms Control and Disarmament Agency. Its budget is less than twenty million dollars as compared to the three hundred

billion spent by the Department of Defense. What is even more serious, in this administration, you have to prove that you do not believe in disarmament to become a member of the Arms Control Agency's staff or its director. Even Gene Rostow, hard-liner that he is, was regarded as dangerously committed to peace and rather unceremoniously tossed out of the job when he let that slight bias show.

So we need allies, lots of allies, if we are to achieve either the understanding in the scientific community or the public understanding solid enough to change this very dangerous course that the superpowers and even some of the smaller nuclear powers, like France and England are following. To say nothing about keeping the aspiring nuclear powers, like Pakistan and Argentina that are spending large sums of money in an attempt to become nuclear powers, from making our continued existence even shakier.

When I say that we peace seekers are outnumbered by the people who have a vested interest in the continuing arms race, I do not mean, as I said, that we are outnumbered just a little bit! There are hundreds of thousands of people in the government and in industry with vested interests in inventing, building and selling new and more weapons systems. They are part of the largest industry in the country—a multibillion dollar industry! They believe that the only thing wrong with the United States military program is that it is too small.

Incidentally, it is not that these people are consciously venal, at least not all of them. Armaments and arms strategy is the only thing they know. They have spent much of their professional lives building weapons and futilely trying to understand how these weapons might be used to advantage. They are part of

a culture that believes its products are essential to America's survival as a free society. Mostly they have never had the opportunity to see or try to understand the intelligence information which makes their new weapons systems urgent; they just know they are needed.

These people have never had the opportunity to reflect on the assumptions that have generated the arms race—as I am going to challenge you to do—on the long-range consequences of their actions, or even what they could do about it except quit and try to find another equally profitable employment, which for many of them does not exist so they do not like to think about it. Most of them are just cogs in an enormous machine that they neither understand nor can affect, and if they did understand and tried to affect would reject them as certainly as a living body rejects a foreign substance. Incidentally, I am certain that they have their counterparts in many European countries, including the Soviet Union.

But I must hasten to say that not all members of the so-called military-industrial complex are as innocent as I have indicated. I know many whose motivation is solely a business interest or is based on distorted ideology, but whatever the motivation they constitute a major, unstoppable, driving force of the arms race. However innocent and even patriotically motivated are the individual involvements in the arms race, the net effect is an out-of-control process, much like a cancer, one that cannot be understood in isolation.

I am going to quote to you from two of your most distinguished West Coast newspapers—maybe I should not say the “most distinguished”—but great papers—somebody will quarrel with me, I do not know your papers all that well—on the subject of the military-industrial complex to add a degree of credibility to what

is often regarded as my biased outlook. In July of 1983, the *Los Angeles Times* published a 16 page special report entitled “Servants or Masters?” I will not read you the 16 page report, but I commend it to you. I found it very interesting. But in an accompanying editorial, the newspaper said,

“Two decades ago Dwight D. Eisenhower warned the Americans not to let what he called the ‘military-industrial complex’ come to dominate their lives and dictate their futures. The nation was not listening. And today a network of defense producers, the Pentagon, and Congress bends policy to its will as he said it would, in every city, every state-house, every office of the federal government.”

It then went on to say,

“What would surprise Eisenhower, as it does us, is the findings of the *Times* investigators that the military-industrial complex has burrowed so deeply into the very fabric of America without even producing reliable or affordable weapons for defense against aggression.”

It goes further than I do!

In a more recent report on the 7th of April of this year, the *San Francisco Examiner* reported on the successful effort to sell the B1 bomber, detailed the history of fraud by the manufacturer in which funds for the space shuttle and other government projects were used to keep the B1 alive after it had been shut off by the Carter Administration. The story went on to outline the company's strategy of placing contracts so widely that almost every state and hamlet has a stake in the B1's future. Even though the bomber is generally agreed to be unnecessary—this is my editorializing—the campaign succeeded. According to the *Examiner*, the average stake per state on the B1 was 700 million dollars. And the states of the 20 senators who lobbied hardest for the aircraft, were scheduled to get sums ranging from one to nine billion dollars! Fight this, I suggest.

Even more disturbing to me is the fact that labor unions and chambers of commerce lobbied vigorously for this marginally useful aircraft, reflecting their

natural concern about employment. But at a time when budget deficits are undermining our economy and interest structure of the society, such actions are clearly counter-productive. Economic data show that dollars spent for defense systems produce only half as many jobs as the same amount of money spent on civilian activities. Such misguided efforts as support for the B1 bomber is only possible because we, the citizens of this country, permit it. Neither of these groups—our groups—understand how unnecessary the B1 is or realize the economic and social consequences of such a vast waste of resources. So we even encourage some of our representatives in Congress to go along with it.

So as I see it, it is no longer a question of doing what Eisenhower suggested, of controlling a military-industrial complex, but rather one of keeping the United States from becoming a totally, military culture—a society in which military ideas and goals are accepted unthinkingly, and every domestic and international problem is subjugated to the demands of the military system. A listener once objected when I made a similar statement, saying I was accusing the leaders of the military-industrial complex of being merchants of death. I had forgotten about that term. But I am not sure they are. They do not want war; they just want to prepare for it. My friend said that he knew many of them, and they were very decent, well-meaning people. And I think he is right. Because we live and they function in a war culture in which it is believed that an ever increasing defense is required for the nation's survival, building and selling armaments is not only an accepted thing to do, but as I have already said, it can even be regarded as a patriotic thing to do.

Nowadays, I spend much time meeting with groups of citizens who have become alarmed, perhaps I should say awakened, to the danger of nuclear war

and want to make their contribution to change in the direction of national policy. Many of them do not understand the technical or strategic issues, and are afraid to push too hard for what their instincts tell them is right. Incidentally, this is the situation of many a political leader, too. This timidity tends to make them so careful that it essentially insures that the arms race will continue because the degree of reassurance/verification such a posture requires—and certainly the opponents of cutting back in the arms race will require it—is neither achievable nor necessary. I will elaborate on this in a moment.

These groups, as I say, need help; they need understanding of the kind that Pief and Sid and many others here have been trying to provide for years, but they need more of it. Also, the millions of home-guard opponents of rampant arms building do not have the time to fully understand the challenges and opportunities they have before them. They are part-time workers. They are challenging full-time career people whose jobs are justifying these weapons, and who are inventing the strategies in which the weapons are going to be used. We have, and they have, because of this from time to time accepted wrong assumptions and premises from the defense establishment as the grounds for the debate. And I think we have on many, many occasions given ground because we were timid and did not realize what total fabrications people like Edward Teller, and some of the other people who I could name, were dishing up. Something I think we now understand.

For example, when the Reagan administration confronted the country with a need to close the now admittedly non-existent window of vulnerability our first reaction was to accept their definition of the problem—the likelihood of a successful Russian first strike against the U.S. land-based missile system—and look for more effective solutions than their proposal: the MX. Only slowly did

we begin to realize that nothing was needed, that adding any new missile system was merely going to add a new twist to the spiraling arms race. That is why I say that we need more Piefs, more arguers, more calculators, more logical people.

The most common question people ask today with regard to the arms race is: "Do we have any choice?" That is because they are suspicious of the goals of the Soviet Union, and so are convinced that we live with a "delicate balance of terror," a phrase invented by a fellow named Walstadter, who has been an inventor of the arms race. If people believe there is a delicate balance of terror, it is easy for an official like the President or the Secretary of Defense or even a scientist with a heavy foreign accent to tell them that if they knew all of the facts and understood them they would agree to support whatever program of the day happened to be—that an arms race is the only road to survival as a free nation, as any fool can see, if they just knew the facts. "Meanwhile, please believe whatever your concerned government tells you."

I think this is a outrage! We know that there is no special knowledge that justifies the arms race. It does not require a Q clearance to know how arbitrary and indefensible are the assumptions that underlie the MX, or B1, or Star Wars, or all the other new toys that we are being asked to buy. It is easy to show that these are not necessary, but the general public does not understand this. In spite of all that has gone on, they still believe that our leaders know something important they do not. They still believe that the President and Secretary of Defense are being advised by experts.

I first began to understand this clearly about three years ago when I gave a speech about the foolishness of the MX at Rice University. At the end of it a lady

stood up and read a scurrilous attack on me which turned out to have come from a John Birch Society publication. Finally after she had gone on for about five minutes telling the group about me, I said "That doesn't sound like a question. Do you have a question?" And she said "Yes, how can you stand up there and contradict all those experts in Washington?" And I said "Name one!" And she said "Secretary Weinberger." And then I understood what our problem was. I think almost any third grade kid who has been playing with a Star Wars disk on his Apple computer could best Weinberger in a question and answer period.

What I have come to realize is there are no experts on nuclear war. I wish I had understood this many years ago. There are experts like me, and like Pief is, and Sid, and many of you here in the room, experts on technical matters. You can be an expert on a missile or a guidance system. You can be an expert on almost any piece of hardware. An expert just means you know more than most other people. You may not know how it is going to work when it is fired in anger. There are no experts on nuclear strategy. And all the secrets cover up is what we do not know.

People on the inside should know better than the outsiders that there are no experts because there has never been a nuclear war of any sort, even though the United States and the Soviet Union have been preparing to fight one for the last twenty-five years. Plans are entirely dependent on theories. And you saw today how confused the world would be if you only had theorists. We have a cold war in which you build big machines, but you are not allowed to use them, which is probably a good idea. Yet most of us non-experts in and out of the military establishment keep talking about a nuclear war as if there were a way of fighting one. Some people even talk about winning one, but it is not easy to understand

what they mean by this phrase. If the arms race has become a way of life for the United States, if we have indeed become a military culture, is there any way out? Barbara Tuchman in her new book, "The March of Folly" that I mentioned earlier, implies that given man's propensity for folly, the only cure for a real case of militarism is the catharsis of war. A cure that does not seem appropriate in the nuclear age.

So you have to ask, is there an alternative strategy without the risks and costs of the arms race that will ensure our security? I believe that the answer is a clear "yes" but to find it will require the reversal of a number of American views on the nature of the arms race, the role of nuclear weapons and of missiles, and of defensive systems. It will also mean recognizing the part that the United States has played, and still plays, in the existence of the arms race. It means having enough understanding of the potential of nuclear weapons for destruction to know their true power and their limitations, to know that there is no military use for nuclear weapons, to know that they are only weapons of terror. It means having the ability to recognize our decisive role in bringing the world to the present crisis and having the courage and the political power to break decisively with the past. And none of these are easy tasks to accomplish.

Looking for alternatives, I think it is important to understand four points which I have already mentioned in a general way as I have talked. But let me repeat them so that they are absolutely clear to you. First—and here I am really repeating myself, but this is the key I think in fighting our way out of this trap—there is no need for secret information or expertise or secret knowledge, specialized knowledge to understand the principle issues of the arms race. Every citizen can be knowledgeable and confident and insist on a voice in the critical

military R & D deployment.

I will give you a simple piece of calculus. For most cities it is reasonable to equate one bomb and one city. It would take a bigger bomb for Los Angeles or New York. If you are a weapons expert you know you should probably use several, "pepper 'em down"; you would get a better effect. In any event, it does not take many. And if you ask yourself: "Where would you put 300 large nuclear weapons to be most destructive?" You run out of vital cities and towns and railroad junctions and power plants before you get to 300. The same thing is true in the United States and the Soviet Union. If I was *not* trying to be conservative I would say 50 bombs, properly placed, would probably put a society out of business, and 300 in each of the two countries leading the arms race would destroy their civilizations. That is a pretty clear-cut fact. If anybody wants to argue about it later, I will be glad to do it.

In any event, on both sides we have on the order of 10,000 bombs. The United States has maybe 10,000 or 11,000 nuclear weapons in its strategic arsenals on land, in airplanes, in submarines, on aircraft carriers. The Soviet Union, we are told, has somewhere between 8,000 and 9,000. And so if you say "OK. I'm really worried about only 50 or 100 of them landing." You have to ask yourself, can anybody believe that either we or the Russians could design an attack on the other's forces that would not leave 1% or 5% or 10% survivors. Would you not agree, that is a large number? So when we spend our time worrying about successful first strikes we have not really thought through how impossible one is. I have been trying to find a number to use as a criteria, and I have been looking at the reliability of television sets as they come off production lines and elevators and all kinds of other man-made machines, and 1% is a very, very reliable figure,

almost never attained. I doubt whether this large military system—that has been haywired together, is run by GIs and has never been tested—would be 50% reliable, let alone the 80% or 90% that some of the strategists think it would.

Now second, I think it is important that we understand the extent to which the United States has been running an arms race with itself, and, as I said, in the process become a military culture—a society in which the arms race is accepted as a way of life. In our reactions to many things Americans and Western Europeans fear, misunderstand and dislike about the Soviet Union, we have built a monster nuclear trap that has ensnared everyone.

Third, as I said earlier, there is no military use for nuclear weapons. Forty years of searching for them have just proven what the wise men said at the very beginning, that this is a weapon so different than anything ever invented before that its only use is as a deterrent, a weapon of terror. And finally, we must see that there are many safe alternatives to the present military policy of achieving nuclear war through an all-out arms race.

When I talk about this subject to public groups I am often told as I said earlier that it is too complicated for the average person to understand. In this view, even though people are frightened by what they see and hear and their instincts revolt, they have no choice but to accept what the "experts" say. Since there are no experts, they are obviously being misled. And secondly, the extent that these issues can be understood at all, they can be understood by anyone willing to make a sustained effort to do so. A few hours of study and discussion a week can soon make a person knowledgeable if not expert, and a truly knowledgeable citizenry will not be so easily misled by the ill-founded claims of the weapons

promoters.

My basic point is that while there are thousands of experts on technical matters and many of them are here, we can all be experts on strategy and doctrine to the degree that it is possible at all on those issues that are the determining ones. What are the additives? What does it take to determine the Russian leaders? How will a massive first strike system operate the first time it is fired? Will people even know where all of the military targets all are?

Many years ago—I do not know what the fact is today—we conducted a test in the United States of our Minutemen. They were all going to be opened up and put into ready firing condition and the lids would not come off a third of them! I do not know if the Russian's missiles are better or worse.

We came out of World War II relatively safe. We built a bomber force, and pretty soon the Russians built a bomber force. We thought they were making missiles, and so we raced real hard and beat them to it. We invented multiple warheads, and they took advantage of that invention and soon threatened us with it. So on and on and on we have gone. We have just deployed weapons in Europe that cut the warning time for the Russians. So in retaliation, they have moved their submarines in closer to the United States. Mr. Reagan says that does not bother him at all. I suppose he is right, but it bothers some of us.

I have been kidding about the theorists and analysts. To be sure they use computer models as a substitute for real experience, but we all know that predictions from computer models are totally dependent on the assumptions, that is the guesses, put in. Such questions as the reliability of missiles when operated by soldiers instead of trained technicians, and fired by hundreds or thousands

instead of singly, reliability of the command and control system, the accuracy of the guidance system, knowledge of the target locations, estimates of target vulnerability, and many others determine the model's prediction. So that the results from a computer model must be pretty questionable. Even when computers are used to design comparatively simple systems like an accelerator beam, a certain amount of trial and error is usually necessary to make them fit. How can we apply these techniques to modeling a massive nuclear war in which there can only be one trial?

In that case we cannot take advantage of any of the lessons we have learned. What I am suggesting is that a degree of realism needs to be brought to this issue and brought to the American people. It needs thousands of Piefs to do this; it needs everybody in this room. It needs our counterparts all over the country, not because we have technical expertise, but because we know about the technology and can say it is not the only thing that matters, these other things matter even more.

I have collected some data. This is all Sid Drell's fault. Since he persuaded me to go back to this business I have been trying to understand what happened during the period when I was involved and was constantly somewhat confused wondering whether I was right and everybody from Edward Teller to the Joint Chiefs of Staff and the head of the Air Force, was wrong and Pief and I were the only ones who were right. And I have plotted much of that data on three slides. This information will show why I say that we have a certain responsibility for the arms race and why I think it puts a major responsibility on us to try to stop it.

Here is a picture of the bomber forces (Figure 1). Some of you who are old

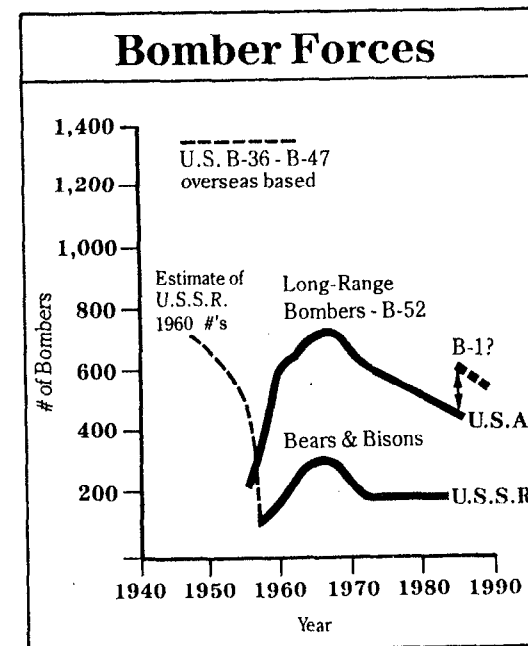


Figure 1

enough—I have the temerity to show this slide because I think physics is a young man's game—and many of you probably were in your diapers back about this time when we had our first scare, when we were told that the Soviet Union by 1955 or 1960 was going to have a thousand long-range bombers and was going to knock out the United States. So we established a crash program to build up our own bomber force, meanwhile our intelligence estimates were slowly coming down. Along about here we built a reconnaissance airplane called the U2 and discovered there were essentially no Russian bombers. I must say, I do not remember anybody apologizing either to the Russians or to the American people who spent about 40 billion dollars building the force to counter it.

Incidentally, while we were being scared—can you see that very light weight purple way up high along about 1,305—you see, we forgot when we started this, we already had a lot of bombers. In fact, my guess is that we had many more bombers than bombs at that time. So there must have been paper devices in some those of bomb bays. But those were B36's and B47's on overseas bases; they were part of John Foster Dulles' "massive retaliation at time and place of our own choosing". Now, I am not implying that the Russians did not do things to justify our being worried about them, but we overreacted. We started along this course; so that you can see that forever after, the United States had a bigger bombing force than the Soviet Union. It is perfectly clear that they never did undertake an enormous bombing force. You can argue that it never occurred to them that they wanted to do it. You may also argue that it turned out to be logistically impossible, that is the base structure that we had was not available to them, and so they early turned to missile systems.

We then began to worry about missiles. And along I guess about in here

several of us in the room became members of something called the Tea Pot Committee. Its report is still protected by secrecy so I cannot get the intelligence we were given then. Our intelligence capabilities were rather poor then although we had some about the rapid development and build-up of Soviet missiles, but it was exaggerated. The United States then had a medium-range missile program and so we could rapidly create the Minuteman intercontinental missile system. Our worry was that there would be several hundred Russian missiles in this time period and there might, in fact, have been. We do not really know much about Russian missile history, but it turned out that the first Russian missile was developed when they believed that secrecy would protect it adequately. It was an enormous, big thing. My guess is it was designed before fusion bombs were invented, and, therefore, it had to be capable of throwing ten or twelve thousand pound warheads.

But in any event, it turned out to be just right for launching Sputnik. It could boost an enormous satellite into orbit. When the United States began to fly reconnaissance planes and it also became clear it would also have a reconnaissance satellite, the Soviet Union was suddenly open, and that largest missile probably looked like a pretty poor military weapon. It took two hours to fuel, it sat above ground, probably could be destroyed by one half pound per square inch over pressure, and so if the Soviets had ever intended to build it in quantity, they stopped. So this is what the realistic curve looked like (Figure 2).

So when you read in papers of the Committee on Present Danger that the United States is responding to the world's most dramatic build-up of missiles, take what is said with a grain of salt. Our planners would have been happy if the Russians had folded that yellow line over and stopped right at the green

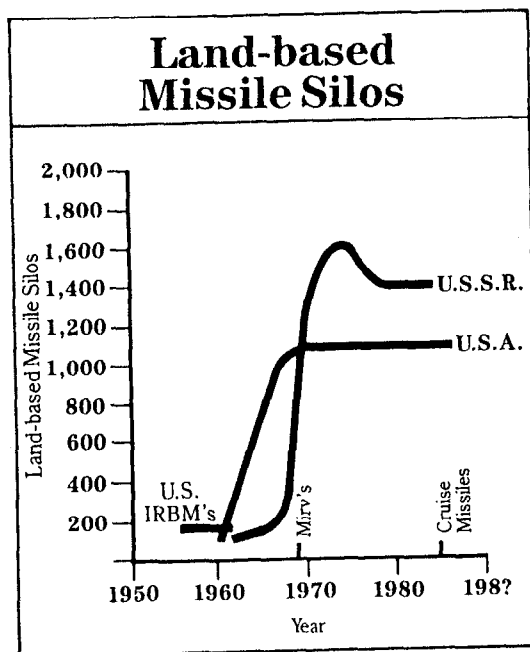


Figure 2

line. But when they crossed, everybody got nervous and it is that gap plus the fact that a much larger fraction of their missile force is on land than that of the United States and therefore can be more accurate that has caused the dilemma. On the other hand, it seems to me, if you understand the nature of the build-up, you can be more relaxed about it.

There is a lot more I could tell you about the history of these weapons, but in deference to the time will move quickly. Figure 3 shows what has happened to the weapons' stockpiles. It shows, of course, for some substantial period of time the United States' stock pile was substantially bigger. And here is the point where the two countries became more or less equal and the situation seemed more dangerous. That curve looks like the energy of accelerators, going to infinity and very fast. In fact, I have not tried to fit on to that curve where the present United States programs will take it, and I do not know enough about the Soviet program to predict theirs, but it clearly does not give me any comfort to see them going up so fast. I have also drawn here my idea of a more than adequate deterrent. One thousand warheads is very conservative.

I have a curve, but I have not put it in this collection, of what has happened to reaction time. It has gone from hours, to fractions of an hour (that is for ICBM's) to a few minutes with the short-range missiles. If people really succeeded in making stealth covering for missiles and especially cruise missiles reaction time will be close to zero. Then the argument to have a so-called launch-on-warning/respond-under-attack mode will be very strong and we will have a situation where the war decisions will be entirely in the hands of machines rather than a President. I suppose you could take your choice.

I am going to stop at this point. I hope I stimulated you all to give up physics and go to work on this problem. Thank you very much.

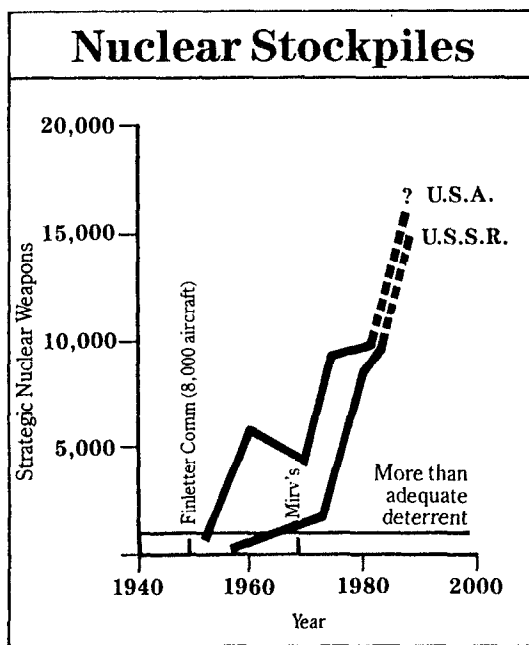


Figure 3