GEORGE DRAPER MARCH 5, 1987

STRATEGIC DEFENSE INITIATIVE (STAR WARS)

Annihilation Averted - It's All Done With Mirrors

Edward Teller conceived the idea of defense against missiles through application of a third generation of nuclear weapons -- the focusing of the tremendous power of the hydrogen explosion into a narrow beam of direct energy, an X-Ray or neutron beam.

In 1982 he presented this exciting Star Wars concept to President Reagan and convinced him that such a defense system was feasible. President Reagan, without consulting the defense and national security channels, and without participation and approval of top Pentagon or State Department officials, wrote his Star Wars speech in longhand, and delivered it. It is of interest to note that his White House advisers had earlier decided, after a years careful study, that anti-missile defense was not plausible.

According to Department of Defense testimony, the cost could be as much as a trillion dollars.

The official line of thinking of the military is set forth in a report by Dr. Simon P. Worden, a Lieutenant Colonel in the U. S. Airforce, and former assistant to the director of the SDI organization in the office of the Secretary of Defense.

According to Dr. Worden, the advanced Star Wars approach cannot furnish near term protection. In his words, "We are much closer to a defense that works than most of us realize or than we had dared hope in 1983. Effective strategic defenses in the 1990's can use 1980's military technologies -- precision guided missiles, sophisticated microcomputers, and [illegible]."

and heat seeking sensors."

Recent developments, he states, have complicated the earlier, simpler problem of intercepting an intercontinental ballistic missile. Originally the missile's flight could be grouped into three phases, the "boost" phase, taking several minutes, the "midcourse" phase, taking possibly thirty minutes and being the "ballistic" arc hundreds of miles from the earth's surface and many thousands of miles in length, then the "terminal" phase, a minute or less as the warhead plunged into the atmosphere and on to its target. The complications arise from new, varied means of delivering warheads.

One new method is the Multiple Independently Targetable Re-entry Vehicle, bearing the acronym MIRV. An example is the Soviet SS-18 which can carry ten or more warheads, each capable of reaching a different target.

Another would be a "depressed-trajectory" missile, a low flying missile, difficult or impossible to detect by radar.

Still another would be a warhead possessing the ability to maneuver in its terminal phase after entering the atmosphere.

Response to these variations requires a highly sophisticated military strategy.

To outline the defense problem, Worden lists the three traditional categories of defense. These are point, sovereign area, and global.

In historical or traditional terms, point defense would have been a city, or a vital harbor. Defenses would have been designed to protect these single targets.

Sovereign area defense, in earlier conflicts, could have been entire seaboards, defended by short range ships, while global

defense would historically have involved our navy, on alert to move to any deep water point on the globe to defend us or our allies.

Now, relating this to missile defense, point defenses ordinarily operate only in the terminal phase, the final minute of the warhead's flight. Sovereign area defenses can operate in the terminal or midcourse phases, dependent on early knowledge and sensor tracking. Global defense would have most, in fact practically all, of its elements based in space.

Hardware for a missile defense system fits into three categories: sensors, weapons, and battle management. Sensors and weapons we readily understand. Battle management is the brain, and of necessity would be essentially computers which could, with enormous speed, decide which weapon to assign to each target, then maintain an overall comprehension of the minutes long battle as it progressed.

Worden makes one frightening statement. It is this; "Today we cannot stop even one missile from falling on the United States." At the same time Russia has its Galosh system to protect Moscaw. This Galosh system was completed in the 1970s and is presently being upgraded. In addition they have a nation-wide air defense weapon, the SA-12, which is capable of making tactical ballistic missile intercepts. Some experts believe this SA-12 could nullify both submarine-launched and land-based missiles.

Worden's stated approach to determining whether any strategic defense posture will be effective, is to "consider achievements, prospects and problems in developing sensors, battle-management systems, and weapons for point, sovereign-area, and global defenses." From his analysis he concludes

that definite progress has been made since SDI was initiated in 1983, and further that we are now sufficiently far into the program "to talk, with some degree of certainty, about the evolving defense systems of the 1990s, their cost and their presumed effectiveness."

Taking Point Defenses first, we already have the sensors. The radars employed for the aborted Sprint anti-ballistic-missile defense system of the 1970s are suitable for point defense. Our air defense system radars can detect ballistic-missile warheads. We need big early warning radars. Russia, unfortunately, is ahead of us with their Siberian radar station at Krasnoyarsk, built in blatant violation of ABM treaty terms.

No longer are nuclear bombs required to kill the incoming weapons, for today's on-board guidance sensors pick up the target, guide the missile to it, and kill it either through conventional explosion or simply by crashing into it.

Point defense is most useful as a deterrent if designed for protection of our ICBM bases rather than our cities. Too, point defense would be worthwhile for protection of the NATO facilities. We have about a thousand missiles there, but the Soviets have several thousand tactical ballistic missile warheads aimed against them. At about a quarter of a million dollars each for interceptor rockets, our NATO facilities could, according to Worden, be protected for a few billion dollars.

Now, concerning Sovereign-Area Defenses, we do have operational the large phased-array-radar sensor at Grand Forks, North Dakota, a part of the Spartan system of 1970. It has some value, for a limited area.

We need, Worden says, to get our sensors airborne.

On AWACS planes we could find and track missile warheads by using infra-red sensors to detect heat from the warheads. In addition small lasers operating from the aircraft could measure the distance to and speed of the incoming ICBMs. The Airborne Optical System (AOS) could relay the information to the interceptor missiles, thereby guiding them to their targets. Some of these technologies are to be tested in 1988 in the Army's Airborne Optical Adjunct experiment. Following that, an AOS system could be built in from five to seven years.

Phenomenal accuracy has been demonstrated by our heat seeking interceptor missiles in space. The ERIS program (Exoatmospheric Re-entry Vehicle Interceptor Subsystem) could be ready for deployment in the early 1990s. With proper sensors one ERIS site could provide limited defense of this country, or Western Europe.

Another area-defense interceptor, the HEDI (High Endo-atmospheric Defense Interceptor) would work inside the atmosphere. This system could also be ready to deploy by the early 1990s. HEDI would function essentially as a safety net for warheads which escape ERIS attack, or for depressed-trajectory warheads. Such a system would be quite limited geographically, able to protect an area about the size of New York state.

Strictly as an interim measure, and permitted under the ABM Treaty, a version of ERIS could be installed in about five years, and could use the existing North Dakota Safeguard site radars. Admittedly this deployment would be ineffective against a full scale attack. Its effectiveness would be limited to the nullification of an accidental enemy launch of a small number of missiles.

In from seven to ten years, an advanced ERIS could be installed. This would consist of several dozen AOS sensor equipped aircraft and a few thousand interceptors. The total system would cost about ten billion dollars, and would easily nullify many times that amount of cost in offensive missiles. It is unfortunate that we would be unable to deploy under terms of the ABM Treaty.

Now let us consider Global Defense.

The technology is available now to put in place a global defense in ten years. Our approach would be to station early warning satellites deep in space, these satellites to function as our initial global defense sensors. These sensors could immediately detect the enormous blast of heat created by an enemy ICBM booster as it is lifted into space, could track it and instantly send information to the battle management system. Technology now in prospect could identify and track even the cooler warhead after its release from the bus.

The military's current concept for an interim global defense is this; place thousands of small (a few hundred pounds each) defense missiles in orbit. These missiles would be stored in readiness on satellite carriers. Upon being alerted by the sensors, battle-management could in turn alert, program, and dispatch the defending missiles from their carriers. The missiles, programmed with knowledge of their individual targets, would fire small rocket motors to home in and crash into the enemy boosters.

As for cost, Worden gives a rule of thumb basis, an estimate of $10,000.00 per pound. Even assuming that the

defender missiles weighed a thousand pounds each, two thousand would cost about twenty billion dollars.

In Worden's opinion, and I quote, "Space-based global defenses are the key to a successful defense. Since these defenses are global, they would confront an aggressor's missiles worldwide from the moment they were launched, regardless of whether the missiles rose from the sea or from the land, from the Soviet Union or from its allies. With sovereign defenses, point or area, the aggressor can concentrate his forces to break through at the most vulnerable point. But global defenses would be everywhere and 'self-healing,' in the sense that a hole in the defense quickly fills as other defensive satellites orbit into place; hence, the aggressor cannot easily plan, time, and focus his offensive missile launches to overwhelm the defense. For this reason global defenses have been public enemy number one to the Soviets. Global defenses, even in small numbers, complicate an aggressor's plans to the point where he must abandon any hope of delivering a knockout blow to his intended victim."

The global defense outlined could be put in place by the mid 1990s. In Worden's opinion, it could disrupt a Soviet first strike, and with some upgrading could make the Soviet's trillion dollar missile force completely obsolete, for the cost of less than a hundred billion dollars.

Finally, Worden addresses the more exciting "Star Wars" concept. These advanced weapons, including lasers, particle beams, the so-called death-ray weapons, will be developed and be used, but not until the early twenty-first century. A "neutral-particle beam," if sufficiently powerful, could melt

a warhead. Weaker beams could probe and distinguish between decoys and warheads.

We now plan to build, in the New Mexico desert, an enormous free-electron laser, which will require several square miles. The power requirement for this laser will be that of a power plant with capacity to serve one of our larger cities. In use as a weapon this laser beam could be bounced from the mirror of a geo-synchronous satellite down to a "fighting-mirror" on an orbiting satellite, and directed to strike, within a third of a second from the time of firing, an enemy missile. It would be capable of striking even a Soviet missile with a fast-burn booster, in case the Russians decide to use this high speed, high cost weapon. Such an enemy fast burn booster would cost 100 million per warhead. It would cost the Russians a trillion dollars to equip their entire arsenal with fast burn boosters, and, according to Worden, we could still shoot them down with laser weapons.

All of this is Worden's view, and supposedly reflects the opinion of our military experts.

The concept is staggering; the cost is horrendous; the feasibility is questionable: the questions provoked are involved and endless.

The key question is survival; personal, national, international. Today's strategy is based on the fears of mutual, total annihilation. Surely there must be something better.

The science of SDI is certainly intriguing. Let us skip the more familiar near-term ABM defense, already sketchily outlined, and consider the problems which must be solved to establish an effective twenty-first century laser type defense.

We must make some large assumptions, for it was only in 1985 that electron beams were propagated into the atmosphere. While bearing the promise of a high level of target lethality, in October of that same year Aviation Weekly reported that such beams emitted into the atmosphere immediately became unstable, and curved to strike the ground, or even circled and returned to strike the generator. Despite this stated problem, let us assume that in time a useful lased killer beam, of whatever type, electron, neutron, X-ray, photon, or other, can be generated. Keep in mind that the energy input will be that of a monster power plant, sufficient to supply a large city. Herein lies the reason for the beam generation to be earth bound.

Following the generation of the beam it must be refined and aimed by optics to travel in a tiny path to a mirror on a geo-synchronous or geo-stationary satellite, about 22,300 miles from the earth. Disregard the problem of aiming: hitting the 30 foot diameter mirror is about the simplest problem of all we are going to have. What about the prisms, lenses, and mirrors which must refine and direct the laser beam without melting or distortion? What about the intense heating of small localized regions of the air as the laser beam goes through causing "thermal blooming," which can defocus and diffuse the beam's energy? What about another atmospheric interaction phenomenon, the stimulated Raman scattering, which converts laser radiation to different wavelengths, robbing the beam of part of its energy? We have little knowledge of what may happen.

Still, assume that these problems in turn are solved. The narrow beam has struck the first mirror on the stationary

satellite. Battle management has selected one out of the thousands of incoming ICBMs to kill, and in some way has communicated the exact position the mirror must assume to reflect the killer beam to an orbiting "fighting-mirror" satellite about 35,000 miles away. Keep in mind that the orbiting satellite will be speeding along in a curved path at a rate of about 18,000 miles per hour, or about five miles, or 26,400 feet, per second-- not in a straight line, but in a curved orbital path. From elementary physics we have learned that light travels about 186,000 miles per second, with either an electron or a neutron beam traveling a bit slower, thus about one-fifth of a second is required for beam travel between the mirrors. During this time the fighting mirror will travel almost a mile.

Complicated? Yes. Still, all this is simple compared to the final stage. Presumably programmed by battle-management, the fighting mirror must be so positioned, at the exact billionth of a second the beam strikes, to bounce the killing force in a perfect carom shot at another moving target, the enemy ICBM, and hit it in a lethal spot. The ICBM will be moving thousands of feet per second on a ballistic course, constantly changing from gravitational and propulsion forces.

These problems appear insurmountable, but there are many, many more. Let us take two only.

To position themselves to bounce beams it is assumed that the satellites will fire small bursts of gas. Obviously the amount and velocity of the bursts of gas must be exact within an unbelievable tolerance, and herein lies a physics problem. The maneuverable mass of the satellite is diminished with each

burst, thus calibration must continually be altered to assure accuracy of maneuver, but there is no way of weighing the mass, for in earth's orbit scales are useless.

Problem two relates to the mirrors. Think about the extreme cold of space and its effect on a thirty foot diameter glass mirror. Glass is nothing but a supercooled liquid. Consider the intense heat and energy that will strike the frozen liquid glass, glass which must maintain its integrity of shape for hundreds of firings.

One could continue to cite technical difficulties, such as battle-management software on the order of one hundred million or more lines, and its reliability in what must be untested battle conditions.

Even if we overcome the technical difficulties we may be very certain that any such weapons we deploy will be vulnerable targets for the Soviets. It will be much easier for them to destroy our weapons than for us to use them.

Concerning feasibility of the SDI concepts and proposals, more than 6,500 college scientists, including a majority of professors in 109 university physics and engineering departments, have declared their opposition to SDI and have signed a "pledge of non-participation" in a project they have called "ill-conceived and dangerous." This group includes 15 Nobel prize winners.

The scientists no doubt know things that have not found their way into generally available or unclassified publications, but even with published information it can easily be seen that both beam and ABM defenses against missiles are very nearly an exercise in futility.

The most telling argument against any useful scheme of missile interception is a little known phenomenon, a force known as

electromagnetic pulse, or its acronym EMP.

In July of 1962 the United States tested a 1.4 megaton H-bomb high above the atmosphere, some 258 miles over Johnston atoll in the Pacific. In Hawaii, 800 miles away, something bizarre happened at the same time. Street lights went out, burglar alarms sounded, and circuit breakers in power lines popped open.

Later it was found that there was a direct connection. Gamma rays hurled earthward from a nuclear explosion hit the air in the upper atmosphere and knock out Compton electrons. These electrons are deflected by the earth's magnetic field and forced to undergo a turning motion around the field lines. Through a complex mechanism the electrons emit what we now call electromagnetic pulse, or EMP. This EMP radiates over thousands of miles, striking the earth with a peak strength of possibly 100,000 volts per square meter. Any metal object picks up the pulse. Should the object be an antenna or cable leading to sensitive electronic components, the pulse can cause extensive damage. Any nuclear explosion produces some EMP, but only bursts that occur outside the earth's atmosphere produce these microsecond pulses causing such far-ranging damage to the earth. The force, while exerted for only a microsecond, is 100 times as powerful as a lightning bolt.

Our military scientists know this. They know that if the USSR chose to destroy our entire communications network, they could do it with two pounds of plutonium. This could be positioned above us in an innocent appearing Cosmos satellite, for these routinely crisscross us at heights of from 200 to 450 kilometers. The detonation of such a small device would damage our entire power grid. We would lose all electrical

equipment without its own power supply--traffic lights, radios, computers, televisions. All telephones and military channels would be shut down. The brains of our missiles could be scrambled and our ability to retaliate completely nullified. Planes could not take off: their electronic starting systems would be rendered useless.

Briefly stated, EMP reveals as wishful thinking the supposed 11 to 15 minutes the President should have to issue orders for a counterattack. It is entirely possible that he will have no way of issuing the call to arms, and if he did, our weapons may have been rendered useless by EMP.

The Russians have known this since 1968 or before. At that time a Soviet Ministry of Defense publication reported that "powerful nuclear explosions set off at great altitudes" constitute a considerable threat to ICBMs "because the impulses of electromagnetic energy created by such explosions can put of commission not only the on-board missile equipment, but also the ground electronic equipment of the launch complexes."

Because they know this, some scientists believe the Pentagon and its contractors know that they're building self-defeating systems but intellectually justify their actions on the grounds that the weapons will never have to be used.

EMP gives enormous first strike advantage to the agressor. In itself EMP makes a comedy and a mockery of SDI, for without some highly effective hardening of equipment against EMP any such defense is illconceived and totally useless under battle conditions. The ICBMs will come through, by the thousands.

And such bombs they will be! We don't like to think

about them. The bomb that fell on Hiroshima was called "Little Boy." It was 13 kilotons of TNT in power. Some strategic warheads today equal 8 billion tons of TNT, the equivalent of 600,000 Little Boys. Did you know that all the old style bombs the Allies dropped during World War II equaled only 2 megatons of TNT? That is one tenth of one 20 megaton bomb. One such 20 megaton bomb would flatten everything in a 200 square mile area. Nothing living would remain. That's one bomb--but thousands would fall--tens of thousands of times the total destruction of World War II. It is highly doubtful that any animal or vegetable life on the earth could survive.

Robert Bowman, former head of the Air Force Systems Command Space Division, said of the various Star Wars schemes, "All have staggering technical problems. All are likely to cost on the order of a trillion dollars. All violate one or more existing treaties. All are extremely vulnerable. All are subject to a series of countermeasures. All could be made impotent by a series of alternative offensive missiles and therefore would be likely to reignite the numerical arms race in offensive weapons.

All would, if they worked, be more effective as a first strike than against one. More important, all would be extremely destabilizing, probably triggering the nuclear war which both sides are trying to prevent."

So, it's easy to make a case against SDI. Opponents of SDI will continue to declare that the time for game-playing, grand-standing, bullying, challenging, sabre-rattling, and fooling the public with mirrors is all over, that there is no real alternative to negotiation, disarmament, and cooperation

if we are to avoid the apocalypse.

In the real world, however, decisions are not so simple. We face an enigmatic and implacable enemy, incapable of being successfully appeased, or dealt with in full faith. Any unilateral approach to disarmament by us would be considered stupidity, an absense of will and resolve, by the Soviets. They understand one thing well--strength; apparently they are terrified by our SDI plans and are now more willing to talk, and bargain. For purposes of strategy, if for nothing more, we should at a minimum continue experiments on and development of interceptor missiles, sensor devices, third generation nuclear weapons, effective shielding devices against EMP, and without question we should maintain approximate parity in weapons, with full inspection rights in case of any developing partial disarmament agreements.

Already the Russians have a beam weapon (a picture of it has appeared in Aviation Weekly and Space Technology). There are even unconfirmed reports that the Russians are even now a year or more ahead of us in varied facets of Star Wars, and that they already have fired their beam weapon at our satellites (this is heresay: there is nothing published.) Certainly for the sake of counter-weapons parity, we must not fall behind the Soviets in weapons technology; research and experimentation must be adequately funded and continued.

Perhaps our greatest concern should be that of self-delusion, thinking that ABMs and beams will be a fully effective shield, or even a moderately effective shield, in blocking off a rain of thousands of Soviet missiles.

All this is comforting to think about, but don't bet your life on it.