assault. Russell's crew acted to suppress the development of nuclear physics during the 1920s, and in the 1930s turned to organize nuclear weapons-policy as an instrument for creating world government. Atoms For Peace, never; atoms for world government, always.

Daniel Graham's only interest in ballistic missile defense, was to create for Wall Street's defense contractors but another opportunity to loot the public till.

What poor wretches Lanouette and Heppenheimer appear to be, when the facts are taken adequately into account.

'Brilliant Pebbles' Are Not That Smart

In its April 13, 1990 issue, EIR *published this assessment, by Charles Stevens and Carol White, of the "Brilliant Pebbles" idea for anti-nuclear missile defense, referenced in LaRouche's memo above as a proposal of Lawrence Livermore National Laboratory.*

The idea of going with a kinetic energy weapons (KEW) ballistic-missile defense, as a first stage to precede deployment of an ABM system based upon directed energy weapons, was devised by Dr. Edward Teller and his associate, Dr. Lowell Wood, in collaboration with other Strategic Defense Initiative (SDI) scientists, as a means of breaking through the apparent impasse which had stalled the SDI, as the pace of disarmament negotiations with the Soviets increased. These 100-pound missiles would each have advanced computing capabilities which—so the proposal went—would obviate the problems of centralized systems control for targetting, allowing for flexibilities and significant cost reduction.

Since 1982, and particularly after President Reagan's March 23, 1983 policy statement which established the SDI as such, Lyndon LaRouche and we, his associates, have been extremely critical of basing an anti-ballistic-missile defense system on kinetic-energy weapons. LaRouche's proposals, which had been instrumental in President Reagan's original definition of the SDI, had all been based upon the use of new physical principles—lasers, electron beams, and other applications of what are fundamentally plasma processes. We were particularly critical of proposals by the High Frontier grouping, whose major spokesman was Lt. Gen. Daniel Graham (ret.).

High Frontier advocated the use of off-the-shelf KEW technology for a spaced-based anti-missile defense system. At that time, we proved conclusively that his system would not be effective, and would also be prohibitively expensive. Recent studies have shown that despite its apparent advantages, the Brilliant Pebbles design bears all of the hereditary flaws of a KEW system. We therefore submit that going with a flawed system, as a means of keeping the SDI alive politically, is the reverse of having one's cake and eating it. It's a situation of: If I win, I lose.

The resources required to put the Brilliant Pebbles into place would prove, in the not-too-distant future, to have been misspent. This would not redound to the political benefit of the program, and, most important, it would not give the United States, and any allies who adopt it with us, an adequate defense against a Soviet missile attack. . . .

The Problems with the Pebbles

Detailed simulations have already shown that Brilliant Pebbles don't make it as missile defense systems. Summarily, this can be stated as: Shooting bullets with bullets is a very hard thing to do, even in the case where the bullet—the Brilliant Pebble—is actually travelling at twice the speed of the missile which it is attacking.

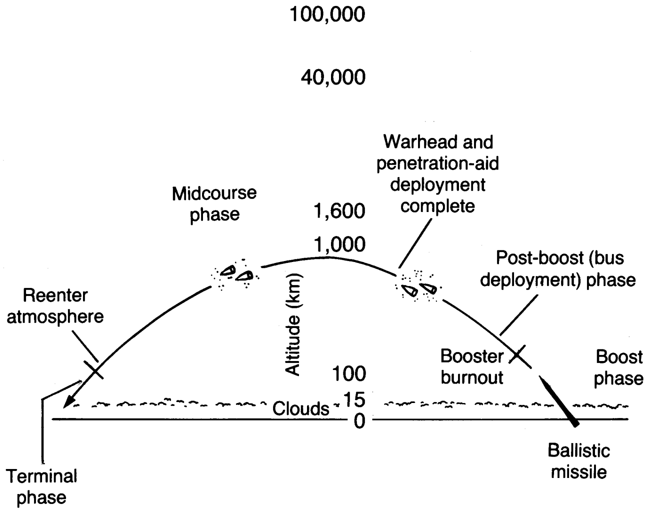
A satellite in low-Earth orbit travels at about 7.61 kilometers per second (kps). An intercontinental ballistic missile (ICBM) at burnout travels at about 6.5 kps. The Pebble could accelerate to a velocity of 11 to 14 kps, only about twice the speed of the missile which it is attacking.

This question of the relative speed of the Pebble versus its target missile, means that a considerable number of missiles must be orbiting over the Soviet Union at all times, in order to have any chance of effectiveness. The ratio of missiles in position to fire at ICBMs, to those in orbit in more distant locations, is known as the absentee ratio. For every ten Brilliant Pebbles which are deployed, about one will have an opportunity to intercept a Soviet booster.

It is necessary to consider all four of the phases of flight of a ballistic missile (see **Figures 1** and **2**). In its first, booster stage, it is an extremely attractive target. This phase can last up to five minutes. The large missile is launched and is slowly accelerated to the velocity of 6-7 kps needed to travel "ballistically" from the Soviet Union to the United States.

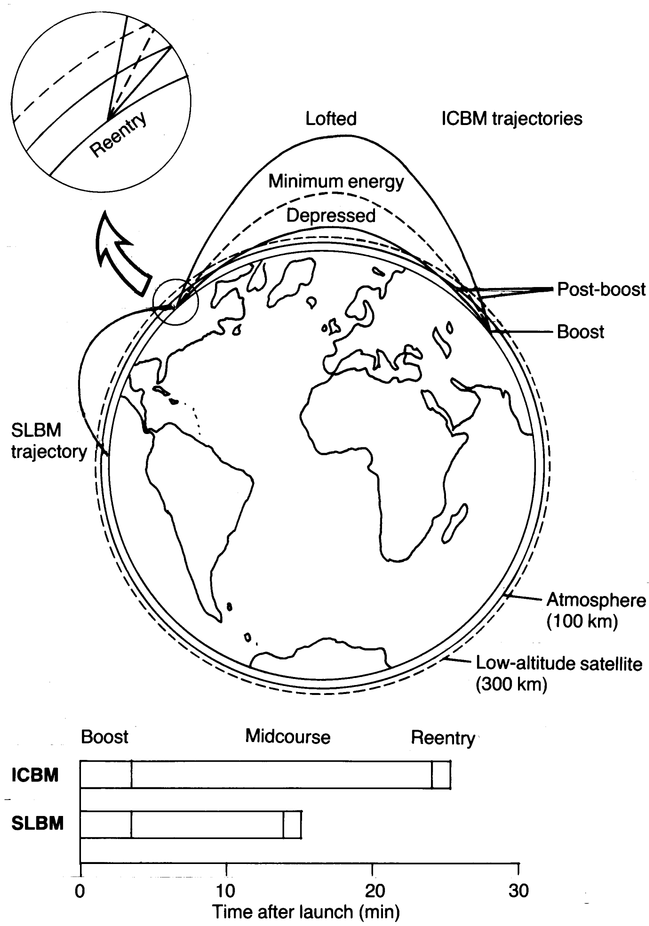
During this boost phase, the missile, with its large engine exhaust, makes an easy target to see and track. In the second, post-boost phase, the post-boost reentry vehicles (RVs), which actually carry the thermonuclear warheads, are deployed by the last rocket stage of the missile—what is called the post-boost vehicle (PBV). It resides in the nosecone of the ICBM. This deployment leads to having each RV take an entirely independent course, which sometimes means toward

FIGURE 1
Phases of a Typical Ballistic Missile Trajectory



During the boost phase, the rocket engines accelerate the missile payload through and out of the atmosphere and provide intense, highly specific observables. A post-boost, or bus deployment, phase occurs next, during which multiple warheads and penetration aids are released from a post-boost vehicle. In the midcourse phase, the warheads and penetration aids travel on trajectories above the atmosphere, and they reenter it in the terminal phase, where they are affected by the atmospheric drag.

FIGURE 2
Trajectory Phases



The above diagram gives a truer picture of the trajectory of an intercontinental ballistic missile (ICBM range = 10,000 km) traveling from Siberia to Chicago. A submarine-launched ballistic missile (SLBM range = 5,000 km) trajectory is also shown in the lower left. Because of its much shorter path, the SLBM spends less time in space and moves at speed many times less than that of the ICBM. Because of its shorter time in space, the SLBM is less able to make use of lightweight decoys. The diagram also shows the rough trajectory of a low-Earth orbit for a satellite. Various ICBM trajectories can in principle be utilized: 1) depressed, 2) minimum energy—the trajectory that involves the least amount of rocket fuel, 3) lofted.

separate targets that are hundreds of miles apart.

This final stage of the rocket and its PBV is much more difficult to detect and track than the booster, because there is no large, hot, rocket-engine exhaust. The post-boost phase can last up to ten minutes.

In the third phase—midcourse—the RVs fly ballistically, that is, they literally fall to their targets in the United States. Because the RVs are flying through the relative vacuum of space, light-weight balloons and other decoys, which look like or hide the RV, can be deployed and fly along with the RV until the atmosphere is re-entered. This is the most difficult phase for detection and tracking. The RV is cold and has no exhaust. Sensors designed to find and track RVs can even mistake stars for RVs. Decoys and other penetration aids greatly increase this difficulty.

Finally, in reentry or terminal phase, RVs return to the Earth's atmosphere travelling at high speed. This causes a large heat wave to engulf the RV, which makes it easy to see and track again. This phase lasts only a few minutes.

Absentee Ratios

Brilliant Pebbles are thousands of small satellites that orbit the Earth once every 90 minutes. All of these orbits taken together form a constellation. This constellation can be considered to lie on the surface of a sphere whose radius is the radius of the Earth plus the Pebbles' altitude. The orbit of each Pebble forms a ring around the sphere. Relative to the center of the Earth, the sphere and the orientation of each Brilliant Pebble orbit, or ring, is fixed; it never changes.

The Earth spins on its axis within the Brilliant Pebbles constellation sphere once every 24 hours. At any moment of the day, there is roughly a fixed number of Brilliant Pebbles over any part of the Earth, such as the U.S.S.R. In general, they must be in the vicinity of their targets if they are to achieve a kill.

This is particularly so for the easiest kill, the boost-phase missile. Only Brilliant Pebbles near or over the U.S.S.R. during ICBM launches can intercept boosters. Roughly, only one in ten pebbles are over the U.S.S.R. during a ten-minute ICBM launch and are able to intercept boosters. This 1:10 figure is known as the boost-phase absentee ratio. Only about two out of ten Pebbles will have an opportunity to intercept the final rocket-stage PBVs, and only about four of each ten Brilliant Pebbles will be able to intercept RVs in their midcourse.

These intercept capabilities can be found by knowing the flyout range of the Brilliant Pebbles, the volume of space encompassing the trajectories of the targets, and the distribution of Pebbles over the Earth. For example, take the case of the absentee ratio for boost-phase interception. We begin an approximate calculation by taking the land area of the Soviet Union compared to that of the entire Earth: 8,650,000 square miles divided by 197,000,000 square miles. [More detailed calculations of this and other technical issues are discussed in the technical appendix, not reprinted here—ed.] This equals 0.04, or 4%. This means that, given a Brilliant Pebbles deployment to cover the entire Earth, only 1 in 25 will be over the U.S.S.R. at any given time.

Since a Brilliant Pebble passes over the U.S.S.R. in about six minutes, the entire set of Brilliant Pebbles over the U.S.S.R. is replaced by a new set every six minutes. If boost phase lasts for about six minutes as well, then 2 out of every 25 Brilliant Pebbles will be able to engage the boosters.

Countermeasures

Because Brilliant Pebbles achieve kills by colliding at high speed with their targets—a kinetic energy kill—they are highly susceptible to countermeasures and decoys. Since a PBV can deploy decoys, flares, and other countermeasures, and since RVs are surrounded by penetration aids and the like, the probability of Pebble kill against PBVs and RVs is much less than against boosters. Countermeasures for boosters are not practical since they are such a "hot," i.e., easily located, target. A decoy for a booster would have to essentially be a booster itself.

In midcourse, the RV deployed by an ICBM is a cold target. This means that countermeasures, decoys, and the like, need not expend much energy to be effective. If decoys or countermeasures can confuse the Brilliant Pebble just enough so that its intercept trajectory is slightly in error, it will miss its target.

Boosters are the highest-value targets for Brilliant Pebbles. The booster carries upwards of 10 to 20 RV warheads. Therefore, one Brilliant Pebble intercept of a booster is equal to 10 to 20 Brilliant Pebble intercepts of RVs. Also, the probability of a kill is highest for the booster stage.

If the boost-phase kills of the Brilliant Pebbles can be mitigated, the effectiveness of the entire Brilliant Pebble defense constellation can be called into question. This is especially the case when decoys and countermeasures are utilized during the PBV post-boost and RV midcourse phases. . . .

The Question of Cost

In order to be an effective anti-ballistic-missile weapon, the Brilliant Pebbles must prove that they are cost-effective relative to countermeasures. Are Soviet countermeasures potentially as costly as a Brilliant Pebble system? This is hard to answer, but likely not.

The more intelligent backers of Brilliant Pebbles do not directly address this cost issue, but go on to say, "Let the Soviets respond to Brilliant Pebbles with fast-burn boosters and single-RV PBVs. While they are switching over to these new ICBM systems and diluting their own directed-energy beam-weapons research and deployments, Brilliant Pebbles have bought us enough time—and have gotten the foot in the door—to begin deployment of Phase 2 of the SDI: lasers and particle beams."

That is, the Brilliant Pebbles backers reply that directed-energy weapons could then be deployed. And that only these speed-of-light weapons have the firepower, range, and mobility needed to shoot PBVs and RVs (and all their decoys and penetration aids, if they have to) in an efficient, effective, and economical manner.

Some Brilliant Pebble proponents then say that since the Soviets know that U.S. capability to go over to directed-energy systems exists, this will dissuade them from converting their ICBM systems and leave Brilliant Pebbles forever as an effective defense against Soviet missiles. In other words: "We guarantee Brilliant Pebbles' effectiveness by threatening to deploy a more capable SDI." This is more reminiscent of Mutually Assured Destruction than of strategic defense.

In conclusion, Brilliant Pebbles does not offer the kind of missile defense advertised. It is also a poor substitute for an upgraded and more survivable surveillance, intelligence, and communications satellite system. Most significantly, Brilliant Pebbles does not involve the sort of breakthroughs in science and technology represented by directed-energy laser and particle-beam weapons—breakthroughs which promise to revolutionize the civilian economy and help lead to the reindustrialization of the United States.

We know that the Soviets are developing these directed-energy weapons. Our commitment in the West, therefore, should be to outpace them in this area, not to delay U.S. laser and particle-beam development by deploying Brilliant Pebbles.