believe it, the example quoted I don't think proves the question at issue, and may in turn quote a really great man who said once about himself: "I was not always wrong." That was Winston Churchill.

Q: What kind of defensive weapons are feasible and could provide for stability, as you mentioned? ABM? Space weapons?

Teller: I told you that the kinds that we are working on is classified. If I would now begin to give you a list of all the kinds that won't work, somebody could accuse me of having broken the law. I am not going to break the law. Because without law, we could not live in a decent cooperative society. But in this country, though not in the Soviet Union, you can criticize a wrong law, and if the law is, you can change it. And I don't see any group that could better look into the question how openness can be stimulated than the press.

Q: Do you believe there will be war between the Soviet Union and the U.S. by 1990?

Teller: If the freeze people prevail, and if we don't submit to Soviet dictates, then such a war will become likely. If we behave more reasonably, and the first step should be the rejection of the freeze initiative, then I think under the leadership of the present administration, we still have a very good chance to postpone any confrontation, and to create a situation where more and more postponement is possible—where we can do much more than avoid war.

By cooperation with those who are willing fully to cooperate, we can improve the very horrible way of life in the Third World. We can by using technology create a situation where the reasons for war will diminish and keep diminishing. If our allies and we cooperate both in making a stronger defense, and bringing about the origin of real peace, the pursuit of the common aims of mankind, at least in the free part of the world, then in the end even in the Soviet Union where tyranny was endemic—and I here include czarist Russia for centuries—even in that part of the world that in its history has never experienced anything like freedom, even there I think a change of thinking may occur. . . .

I am not telling you that if we can avoid war now, and I think we can, then the golden age will be here. We will have many other problems, and perhaps even greater ones. But I want to have for my children and my grandchildren the chance to confront these new problems, to struggle with them, and to do it as individuals.

Q: You oppose the freeze. You opposed SALT II, you opposed the limited test ban treaty. Are there any arms control agreements you favor? What are they?

Teller: . . . the real measures which I favor are not treaties which start by the word "don't," I am in favor of treaties which start with the word "do," which encourage cooperation and which attack not the means of warfare, but the roots of conflict.

U.S.S.R. advances on beam-weapons work

by Steven Bardwell, Military Editor

The whole structure of Western military strategy, deployment, and order of battle proceeds from the assumption of the unwinnability and unfightability of nuclear war. The clear and painful irony is that our only nuclear-armed adversary does not share that assumption. The Soviet Union has structured its strategic outlook, deployment, and order of battle around the reality of world nuclear war—its fightability, winnability, and qualitative similarity to other kinds of war.

Although many Western observers have characterized Soviet concern over defensive capabilities as paranoid or obsessive, the actual structure of the Soviet defensive deployment is entirely consistent with their overall military strategy, and perfectly rational given their assumption that nuclear war is terrible but fightable. The Soviets have three distinct thrusts to their defensive policy.

Velikhov heads a crash development effort

At one of the U.S.S.R.'s largest industrial facilities, Academy of Sciences Vice-President Yevgeni Velikhov is heading a special program for the development of beam technologies. The economics magazine of the Academy's Siberian Division, *EKO*, has publicized the program in a feature-article section in its most recent issue, calling it an excellent model of the unification of science and production.

EKO reveals that since 1977 (the year Cyrus Vance proposed to Moscow "deep cuts" in both strategic arsenal and advanced technologies, and was sent packing), a team of scientists from the Academy and the Kurchatov Institute of Atomic Energy has been working to build a beam technologies laboratory using the resources of Moscow's Likhachov Auto plant (known as ZIL), one of the very largest industrial enterprises in the Soviet Union. They are working on the construction of laser, electron-beam and plasma devices for commercial applications, thus benefitting the Likhachov company directly, while at the same time expanding the resources of the beam-technology research program far beyond anything previously done. Velikhov is a

The first is a large, high priority, research and development effort. In the Soviet conception, the most certain aspect of the world today is rapid progress in science and technology. While making no clear distinction between civilian and military applications of scientific work, the Soviets have devoted massive amounts of money and manpower to research projects in high-energy density physics (plasma physics, beam generation, pulsed power production, and so on), aerodynamics and astrophysical engineering, and electronics. These fields are those most central to new weapons development as well as to new industrial technologies. In most Soviet discussions, empasis is on first, the prevention of a "surprise" by the West and second, the economic importance of the technologies provided by this research.

The resources devoted to this Soviet research effort are huge. The Department of Defense has testified every year for the past decade before Congress on the large and growing disparity between the United States and Soviet military R&D expenditures. The DOD now estimates that over the past decade the Soviets have made a cumulative $100 billion R&D expenditure beyond that of the United States.

That this Soviet program has been successful is dramatically indicated by President Reagan's statement at a press conference March 31, 1982, to the effect that there were areas of "Soviet superiority" in strategic weapons.

It is frequently argued today, as it has been for the past 20 years, that the Soviet Union cannot afford the diversion of the best scientific and engineering talent to military research. The consensus among Western observers in the early 1960s was that the Soviet Unon would face increasing unrest domestically if it tried to expand its military budget in any significant way, especially in those high-technology areas so needed by the civilian economy. This was an unfounded hope 20 years ago, and is even more unfounded today. The extent of the Soviet military commitments over the past decade, in fact, has been grossly underestimated by all official Western sources. In a recently completed study of the Soviet economy, researchers at the Fusion Energy Foundation report that the Soviet military budget increased by approximately 30 percent in 1975 and again in 1978 (*EIR*, March 23, 1982). These two increases put the current Soviet military budget at a level approximately 50 percent greater than the U.S. military budget. Although this study shows that there have been serious economic strains as a result of these two sudden jumps in military procurement, there are indications that these expenditures can be endured for a considerable time to come.

In the same way that the NASA program in the United States paid for itself many times over through induced productivity, military research in the most advanced areas of plasma physics, space physics, and electronics can profound-

leading figure in the Soviet program of fusion research and development, especially the part of the program devoted to the inertial-confinement method.

The national significance of the program is denoted by the ZIL laboratory's classifiction as "a basic laboratory of the Academy of Sciences of the U.S.S.R."

In an introductory article for the *EKO* feature, Velikhov boosts his ZIL program as an exemplary solution to the delays in implementation of new technologies. Bureaucratic obstacles were eliminated, he writes, when the Academy went directly to the factory management to start the program. For the scientists, "the most important thing is to see the results of your efforts and to have the possibility of taking new approaches toward engineering and technology."

"Time doesn't wait," says Velikhov. "When you are dealing with a totally new technology, it is vital to proceed as quickly as possible from the idea to its implementation by the U.S.S.R. There have been a great number of different opinions by prominent specialists on the future of the laser. Some even said that there was no need for the laser in the workshops. It was precisely at that point that the engineers of the Likhachov Auto Plant foresaw an important task associated with the problems of welding, which could be solved with the help of lasers. We subsequently, together with the plant specialists, built a laser device in two years and introduced a new system of automation. This was possible because our interests coincided with those of the company, and the company did not take a narrow consumer approach to the problem.

"They did not merely consider the short-term results, but looked also at the long-term perspectives of laser technology. We have now built a special laser lab whose work is being carried out on the basis of the full range of engineering services of the company. . . . We will be able to attract other organizations to this technological orientation and to demonstrate a concrete approach to the introduction of completely new technology in industry."

The chief welder at ZIL, M. M. Fishkis, writes in another article that the most important area of collaboration between ZIL and the Academy is "the creation of fundamentally new processes, based on the use of highly concentrated energy sources—lasers, electron beams, and plasmas—as well as the development of labor-saving technologies and automation of production." Praising the "businesslike attitude" of Velikhov's people working at ZIL, Fishkis describes the laboratory's work on laser welding, tempering, and shape cutting of metals. The project has had the closest attention of the Academy, he says, with frequent visits from Velikhov to check on the status of this huge new research and development capacity.

ly affect the civilian economy through the misnamed spin-offs. The critical point at the current juncture is that the Soviet defensive conception of R&D has focused that nation's research on precisely those areas most conducive to future economic payoff: advanced plasma technologies, beam generation and propagation, space development, and electronics. Only in the last area can the United States claim any edge. In the other areas, Soviet superiority is evident, as follows:

Plasma physics. The Soviet Union continues to have the most broadly based and innovative nuclear fusion research program in the world, in spite of severe cuts in funding for civilian applications in the past five years. The bulk of the new approaches and scientific concepts have come from the Soviet fusion research program. The United States has excelled in elaboration and engineering development of ideas like the tokamak, the tandem mirror, and so on, but the basic work on these was done in the Soviet Union. It is because of the large Soviet investment in fusion that they are today ahead of the United States in the development of the beam weapon.

Beam generation technologies. Soviet work in this area, keying off from the Soviet fusion program, promises a break-even electron beam fusion experiment by 1985.

Space research. The Soviet Union continued a large and aggressive manned space program during the 1970s when the United States did not conduct even a single manned space mission. The Soviet Union now launches approximately twice as many satellites each year as the United States, with more than double the payload, and is conducting a series of extensive tests of anti-satellite and antimissile weapons in space. According to DOD testimony from 1982, the Soviets have already developed (but apparently not deployed) an anti-satellite weapon in near-earth orbit and are close to having an anti-satellite weapon capable of destroying satellites in the highest earth orbits. Most importantly, the Soviet Union plans to have a permanent manned space station orbiting the earth by 1985, which will be continuously occupied by ten men; there is no similar U.S. program.

The second aspect of Soviet defense deployment is in the area of civil defense. Despite recent media reports of a Soviet peace movement that defines nuclear war as unthinkable, the Soviet Union is committed to civil defense as an essential part of nuclear war-fighting capability, with a comprehensive, expensive, and serious program for protection of urban and industrial targets. It is clearly committed to the evacuation of its urban areas in time of war, the dispersal of industry, and the sheltering and feeding of critcal cadre of skilled workers, administrators, and military personnel. According to 1981 figures, the Soviet civil defense program has more than 115,000 full-time employees and approximately $2.3 billion per year in expenditures. Authoritative sources estimate that with three days' warning of a nuclear attack, the Soviet civil defense preparations would result in Soviet casualities from a nuclear war not exceeding those they suffered in World War II. These losses would be extremely serious, but the Soviet Union is psychologically and militarily unawed by them. The Soviet military has proven to itself that civil defense works, and they are committed to it as an essential part of a nuclear war-fighting capability.

Third, the Soviet Union has consistently identified ballistic missile defense as a critical component of its overall defense posture. In marked contrast to the West, Soviet military commentators have never regarded the ICBM as an invulnerable offensive weapon, nor have they regarded the dominance of the offensive side of war today as anything but temporary. They, of course, admit the tremendous technical problems involved in ballistic missile defense, but constantly analyze the role of even the rudimentary defensive weapons that do exist against ballistic missiles.

More recently, Soviet research has concentrated on the development of beam weapons for ballistic missile defense. The exact state of progress by the Soviet researchers is not available in the open literature in either this country or the Soviet Union, but the following facts are known:

(1) The Soviet Union has developed a land-based laser capable of "blinding" U.S. surveillance satellites. Using an intense beam of visible light, the Soviet weapon can overload the sensitive cameras in the spy satellites, and, in some cases, can destroy the delicate optics. This weapon has been available for at least three years.

(2) The Soviet Union has developed a land-based high-powered laser capable of destroying pilotless, subsonic aircraft. These experiments have been observed by Western reconnaissance for several years. It is not known if this is a deployable weapon or still a laboratory testbed.

(3) The Soviet Union has tested a number of complex, extremely high-energy power sources ideally suited to beam weapons use. These involve both conventional explosive technologies and nuclear technologies. Advanced MHD techniques have been used to produce pulses of electrical energy of precisely the size and timing needed for directed energy beam weapons.

(4) The Soviet Union has developed a high-energy technology that has been used for ionospheric modification. Using beam technology, this microwave generator would enable the Soviet Union to "tailor" the upper atmosphere so as to block radio transmissions, destroy radar reception, and conduct electronic warfare on a global scale. The engineering state of this development is not known.

(5) The Soviet Union has tested a plasma beam weapon that generates discrete plasma "bullets" capable of long-distance travel. Similar to ball lightning, these plasmoids carry large energies in an electromagnetic field/plasma complex sufficient to destroy a ballistic missile.

(6) The Soviet Unon has tested a high-energy iodine laser, which has successfully downed a ballistic missile. This experiment was a test of a strategic beam weapon, not intended for battlefield use as an antitank or anti-aircraft weapon, but as a ballistic missile defense system.

DOD spokesmen estimate that the Soviet commitment to beam weapon development has put them two to four years ahead of the United States in this program.