will be available to treat and possibly cure diabetes, hemophilia and other life-threatening and chronic illnesses.

Space manufacturing will develop the new metal alloys needed for high-temperature processing using advanced nuclear and fusion energy sources. Larger and more perfect crystals for the electronics and other industries will be produced.

By themselves, these new industries created by exploiting the unique environment of space, "pay" for the NASA programs. But the indirect impact to the economy has been even greater, and more important. These are the so-called "spin-offs" from space exploration which have been developed by industry using technological breakthroughs funded by NASA.

New materials, such as refractory ceramics and new alloys which withstand the temperature extremes of space flight, are used in everything from nuclear power plants to everyday kitchen implements. Developments in electronics, including miniaturization and sophisticated automation techniques, have streamlined the functioning of industry and shortened the time (thereby increasing the productivity) of almost everything we do.

The machines that monitor all of the vital bodily functions of the astronauts who walked on the Moon, now monitor premature infants in incubators, and have provided heart monitors and miniaturized pacemakers for thousands of people.

The same qualitative impact, magnified many times, will result from the development of beam weapons combined with the recommitment of the civilian space program to establish a permanently manned station in space toward the goal of colonizing the Moon and other planets.

However, studies done by Chase Econometrics and confirmed by independent studies using the Fusion Energy Foundation's econometric model show that there is a much greater impact that the development of a qualitatively new technology has on an economy. This impact is, strictly speaking, not measurable by adding up all the new products and new techniques that a new technology introduces; it is the *increase in productivity* throughout the economy as the result of the combination of higher manpower skill levels and new scientific knowledge entering industrial production. One study of this induced productivity effect estimated that U.S. productivity increased 0.1 percent for every billion dollars spent on the space program. This change in productivity alone represented an additional $3 billion to the GNP every year it was present. An interesting comparison is possible between the expenditure of a $1 billion aliquot of the federal budget on a high-technology R&D oriented program (like the Apollo program or the development of a beam weapon) and its expenditure on transfer payments, bureaucratic services, or the like. The Chase Econometrics study showed that the expenditure of this money on high-technology R&D actually *lowered* inflation, while the other expenditure had the opposite effect, raising inflation by 0.2 percent.

Four types of directed-energy weapons

by Mary McCourt

In his *EIR* multi-client report, *Beam Weapons: The Science to Prevent Nuclear War,* Dr. Steven Bardwell describes the types of beam weapons on line for development. Each type, laser beams, particle beams, microwave beams, and plasma beams, is, Bardwell states, "in principle capable of generating the required power and energy [to reach and disarm its target] in a form efficiently absorbed by the missile." A beam weapon effectively disarms a nuclear warhead. A hydrogen bomb can be detonated only by an initial powerful atomic-bomb explosion capable of setting off a chain reaction in the lithium-deuterium fuel. A beam weapon, by pumping energy into the very delicately balanced triggering mechanism, prevents the initial explosion and essentially turns the warhead into a "dud." The missile, like a satellite, might fall to the earth, but it can no longer be detonated.

Scientists agree that laser-defense battle stations, even with the lowest level of laser-beam technology, can be defended from other beam weapons themselves. But a missile cannot be effectively defended from the beam without such massive protection that it would lose both the necessary speed and distance.

Laser-beam weapons

Laser beams, particularly the chemical laser, will likely be the first deployable beam weapons developed. A laser is a beam of very intense, single wavelength electromagnetic waves, either of light or high energy X-rays. Such a weapon can be focused very precisely because either the light or X-ray wavelengths all have the same frequency and phase. The five different types of lasers, which can be applied to fusion energy as well as beam weapons, are all being researched at U.S. laboratories.

The **chemical laser,** which could be developed for military deployment within five years, uses a gaseous medium in which a chemical reaction is induced. The product of the reaction emits laser light. The Soviet Union used such a laser last year in tests that downed a ballistic missile.

In a **gas laser,** a burning gas such as a hydrogen and fluorine mixture is suddenly compressed, and the energy distribution that results from the compression is then stimulated to emit single-frequency light waves at very high energy. Both the United States and Japan are currently using huge gas lasers for nuclear fusion development.

An **electron discharge laser** uses replaceable energy from an electron beam to create the source of laser light. Such a laser would be very efficient for use in space because its energy source is electricity, not an exhaustible chemical fuel.

Two other types of lasers, **X-ray lasers** and **free-electron lasers,** yet to be perfected technologically, have greater advantages of energy density and flexibility than those listed above. The **X-ray laser** is widely recognized as the most promising long-range laser for ballistic missile defense, based in space. The X-ray laser, which is just a single pulse, is by far the most energy-dense, delivering thousands of times more energy per pulse than conventional lasers. In addition, the target absorbs the X-rays very efficiently, making this weapon capable of very efficient destruction of missiles.

Particle-beam weapons

Particle beams also deliver energy in a highly controlled pulse traveling at near the speed of light. But instead of a pulse of intense electro-magnetic radiation, the particle beam consists of **subatomic particles, (electrons** or **protons), neutral atoms** (usually hydrogen), or (usually magnetized) **macroscopic particles** accelerated to high speeds. A particle beam destroys its target, the triggering mechanism, by creating a very intense shock wave within the mechanism, like a very small, but extremely heavy and powerful hammer striking down on the target.

Electron beams can be generated in the range of millions of volts. Scientists researching the electron beam for military or civilian energy use have discovered that the electron beam becomes a complex structure of electrons and a magnetic field. Such structured beams are capable of carrying higher currents and more energy for much longer distances at much great levels of power output.

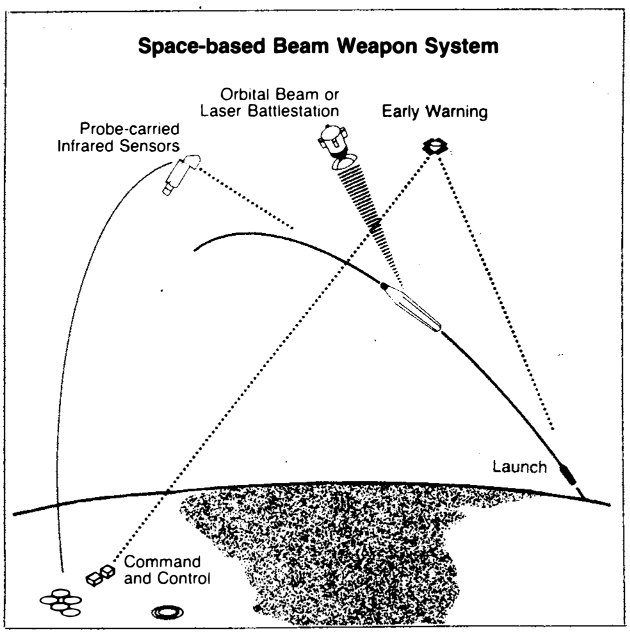
Proton beams, which have been researched intensively for the past 30 years, use an electron beam as a seed and then are accelerated in their own right. As protons are 2,000 times heavier than electrons, a proton beam of the same velocity has 2,000 times the energy of an electron beam.

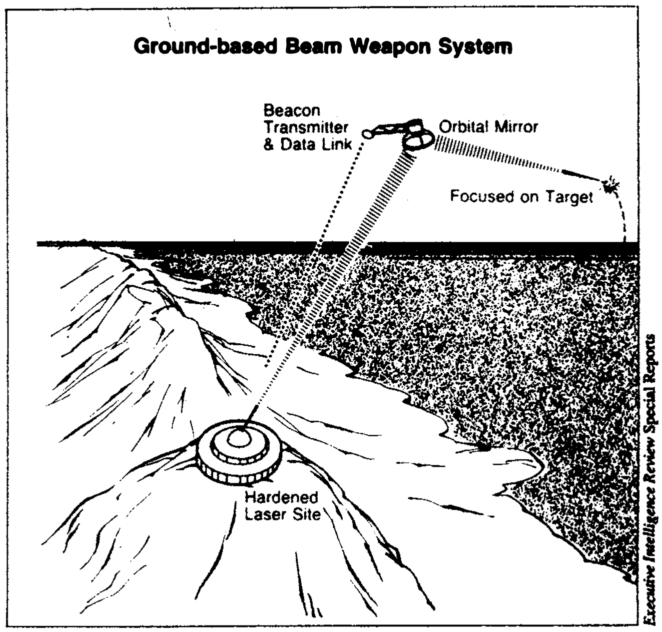
Neutral particles eliminate many of the problems of charged-particle beams, which can degrade both the efficiency and controllability of the beam. By spring of 1983, U.S. researchers will have produced a beam of protons at an energy of 2.5 million electron volts, capable of traveling at 99 percent of the speed of light.

Control and targeting of a **macroscopic particle beam** would be more difficult, but the unparalleled power density of the beam—due to the large mass of the particles—gives it great potential as a beam weapon.

Microwave and **plasma beams** have only been discussed in the United States in the past two years, although it is estimated that the Soviet Union is two or three years ahead in the production of microwaves. Intense, directional microwaves are generated when electron beams are propagated at or near the speed of light through a plasma. Such beams, if focused, could destroy delicate electronic equipment in a target.

A plasma beam consists of the highest energy-dense form of matter, a gas so hot that the electrons and neutrons have separated. The plasma forms itself into a complex structure of particles and magnetic fields. The unique feature of a plasma beam is that it actually requires the atmosphere, which hinders the guidance and propagation of other beams, to hold in the plasma and sustain the structure.





Space-based beam weapons, (left) provide the only feasible means for area defense against nuclear-armed ballistic missiles. The deployment of a weapon capable of generating an intense beam of laser light, atomic particles, or plasma, in an orbit around the earth, would protect the entire United States from incoming ballistic missiles. **Ground-based beam weapons** (right) can provide both area and point defense. Shown here is a conceptual design of a laser beam-weapon system built on a mountaintop, which uses a relay mirror to provide aiming and tracking for the weapon.