nuclear explosion sensors. The latter will be part of a network called IONDS, for Integrated Operational Nuclear Detection System. This system could be used to detect violations of the 1963 treaty banning atmospheric nuclear tests, but the Air Force regards it as a warfighting tool. With its ability to precisely locate nuclear explosions, IONDS could tell the military which targets the Russians had hit in a nuclear first strike. But it could also tell them where in enemy territory American warheads had or hadn't gone off, so that restrikes could be pinpointed on targets that were missed the first time.

The purpose of much of the new military space technology is to adapt satellites for fighting a nuclear war. New early warning satellites will have CCD focal planes in their telescopes, enabling them to plot precisely the trajectory and target of every Soviet missile that is fired.

The new Milstar satellite communications system, which is scheduled to be launched at the end of the 1980s, is a "warfighting system," according to the head of the Air Force Electronic Systems Division. It is designed to maintain communications among airborne command posts, bombers, missile control centers and missile-launching submarines after a nuclear war has broken out. Milstar will also be used by the Army's new mobile command posts, now under construction [see William Arkin and Peter Pringle, page 434]. The Pentagon is also studying the use of lasers in space-earth communications.

Satellite systems today are heavily dependent on ground stations, which control the spacecraft and receive and analyze the data they transmit. Since most of these stations would be destroyed in a nuclear war, the Air Force Space Division is working to make military satellites autonomous. The Milstar communications satellites will be able to send messages to one another, reducing the need for large ground terminals. Having the satellites carry more "on-board signal processing"—computing power—will open the way to the use of simpler, smaller and more mobile readout stations on the ground. A new space sextant will enable satellites to navigate by the stars automatically instead of being controlled from the ground.

As warfighting tools, satellites are being made more survivable. The new DSCS III (Defense Satellite Communications System) satellite is "hardened" against nuclear radiation and possibly against enemy lasers. Some future satellites will be maneuverable so that they can evade Soviet antisatellite weapons. Others may make use of "stealth" technology and remain invisible to Soviet optical or radar trackers until they are needed.

The Russians already have a "killer satellite" that can match orbits with a target and explode nearby. This kind of weapon has drawbacks, however. It is somewhat unreliable (in tests it functioned only about half the time), and it lacks the range needed to hit U.S. early warning and communications satellites, which orbit at an altitude of 22,250 miles. The United States abandoned its nuclear-armed antisatellite weapon, ASAT, in 1975 and is about to test a new antisatellite missile that is launched from an F-15 jet.

In preparation for the new era of space war, the Air Force created a special Space Command last September. But even before then, it was busy improving its Space Defense Operations Center in Colorado Springs and installing new radar and optical tracking systems for monitoring space.

In a war between the Soviet Union and the United States each would be likely to attack the satellites of the other while defending its own satellites. War in space will be an extension of war on earth; it will be part of the larger clash of military forces, each trying to neutralize the other. Carrying the battle out there won't make us any safer down here. □

THE FUTURE

Previewing the Latest High Tech

STAN NORRIS

Nearly a quarter-century after President Dwight D. Eisenhower warned in his farewell address of the "danger that public policy could itself become the captive of the scientific-technological elite," U.S. strategy is in thrall to the weapons makers. And America is not alone in its technological bondage. Philosopher Cornelius Castoriadis, in his book *Devant la Guerre*, argues that Soviet military and technical experts have supplanted the Communist Party as the true center of power in the Soviet Union. In a speech not long before his death, President Leonid Brezhnev said, "Competition in military technology has sharply intensified, often acquiring a fundamentally new character. A lag in this competition is inadmissible."

What American and Soviet leaders have long known but rarely admitted is that technology now shapes strategic policy rather than being shaped by it. Weapons are invented and then missions are found for them; threats are proclaimed that justify those missions, and finally military doctrine swings into place, integrating the new weapons into the master strategic blueprint. Thus, in the days of less accurate nuclear missiles, the cornerstone of U.S. nuclear doctrine was mutual assured destruction. Once weapons capable of taking out hardened missile sites were devised, however, the doctrine of counterforce, expressed in the Carter Administration's Presidential Directive 59, emerged.

Now more and stronger technological fixes are coming—"stealth" bombers and missiles, directed-energy weapons, new kinds of nuclear weapons, artificial intelligence and robotics are approaching the production stage. These new devices will profoundly alter nuclear warfighting doctrines just as MIRV did in the 1970s.

§Stealth. The stealth bomber would be invisible to various detection systems. Stealth first came to light during the 1980 campaign through deliberate leaks by the Carter

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Administration to counter charges that it was "soft" on defense. Stealth incorporates several technologies: the use of nonmetallic materials and special paints to absorb signals and hide "hot spots" that are picked up by radar; special aeronautic designs (perhaps on the principle of the flying wing) that decrease radar visibility; and electronic countermeasures that fool detection systems into indicating the aircraft is somewhere other than where it is.

Although stealth technology is generally discussed in regard to strategic bombers, the Defense Department would like to apply it to a variety of other weapons, including cruise missiles. The Air Force installed only a few of the thousands of air-launched cruise missiles it has ordered, then asked for stealth cruises—a classic example either of technological advances outrunning deployment or, as *The Washington Post* charged, of budgetary gamesmanship. As for the "threat" justifying the stealth cruises, the Air Force points to the Soviet Union's new interceptor aircraft and hypersonic SA-10 missiles.

The competition among aerospace companies for the various potentially lucrative stealth contracts is fierce. General Dynamics, Boeing and Lockheed are vying for the cruise missiles, while Northrop, Rockwell and Lockheed are tangling for the bomber contracts. In a bid to outflank Northrop, Rockwell joined forces with Lockheed to try to win what is likely to be a $25 billion order for stealth aircraft. The two companies have already begun designing a stealth version of the B-1B, called the B-1C, thus obviating the need for the Northrop stealth bomber. As a counterpunch, Northrop offered to deliver its bomber in 1988—three years earlier than scheduled—thus eliminating the need for Rockwell's B-1B.

The potential applications of this technology are vast. In the not too distant future there could be stealth fighter and reconnaissance planes, helicopters, small ships and even tanks.

§ **Directed-energy weapons.** With clockwork regularity, aerospace trade journals like *Aviation Week and Space Technology* turn out scare stories about impending Soviet advances in laser beam and related technology. Their claims of laser "gaps" are sensationalized in the mass media and create public anxiety. Though of some use in alerting the American people to these new weapons, which they will ultimately have to pay for, these horror tales do little to inform the debate over the wisdom—or even the feasibility—of running this new lap in the arms race.

There are two kinds of directed-energy weapons: lasers and the less-well-known particle beams. Laser devices produce a concentrated ray of light, while particle beams are composed of charged atomic or subatomic particles such as electrons or ions and travel near the speed of light. The most frequently suggested application for both technologies is in space-based antiballistic missiles, but other possibilities are being considered. Reagan dreams of building a grand network of lasers or particle beams on satellites approximately 600 miles out in space, which could destroy Soviet missiles within six or seven minutes after they are launched.

For this to work, pulses of light or particles must be expertly aimed and fired at a missile traveling about three miles a second. If they miss or hit a decoy, the weapons must be re-aimed and refired. Obtaining adequate warning and coordinating so elaborate a system against several thousand Soviet land- and submarine-based missiles would be a formidable task. Hundreds of satellites would be needed to cover all launching sites and to comb the ocean for missile-bearing ships and submarines. These weapons require vast amounts of energy since their beams would be diffracted by the atmosphere and bent by the earth's magnetic field. Lasers a thousand times more powerful than those we now have would need to be developed.

Obviously, the first step in any Soviet plan to launch a missile attack would be to destroy or disable U.S. directed-energy weapons. This could be done in many ways with relative ease. The cheapest methods would use antisatellite weapons to jam communications links to U.S. ground control centers or nuclear weapons detonated in space to produce a disabling electromagnetic pulse (E.M.P.) that would burn out communications systems.

§ **Nuclear weapons.** If some recent news stories can be believed, scientists at the Lawrence Livermore National Laboratory are on the verge of breakthroughs in nuclear weapons technology. These "third generation" nuclear devices would accentuate any one of the forms of energy released in a nuclear explosion: blast, heat, radiation, E.M.P. The neutron bomb, which has enhanced radiation and reduced blast, is a crude prototype of these weapons. The possibilities are many. For example, a bomb with radically increased E.M.P. would, in principle, be markedly effective against Soviet communications and electronic systems. Physicist Edward Teller envisions special satellite-launched antiballistic missiles, which, when exploded,

would emit amplified X-ray laser beams to destroy incoming Soviet missiles.

Some of Teller's enthusiasm is shared by the Senate Armed Services Committee. In a recent report, the committee announced it was "especially intrigued with emerging new concepts" and called for a "deliberate, multiyear program" to develop such weapons. In language that has become all too familiar, the senators say the new devices would be for "purely defensive purposes," ignoring the fact that their introduction would make nuclear war more likely. As they say, "These concepts could result in weapons which can only be used to destroy the offensive systems of a potential adversary, and may well render offensive nuclear systems ineffective, thus removing the threat of nuclear war." But the line between "defensive" weapons whose purpose is to destroy the enemy's offensive weapons and offensive counterforce weapons that also destroy enemy missiles is so fine as to be almost invisible.

§ **Artificial intelligence and robotics.** This will be a burgeoning area of research in the 1980s for the intelligence agencies and the Pentagon. Artificial intelligence means "smart" computers—machines which learn, "reason" and make decisions. One C.I.A.-sponsored research project is developing a computer system that can process information and formulate hypotheses based on it. Artificial intelligence is also being designed to automatically translate the huge volume of foreign language intercepts the National Security Agency collects from all over the world.

The military applications of this technology are limitless. Nearing completion is a computerized system that will locate targets and guide missiles to them. Used against tanks, such missiles would scan the battlefield, locate the targets and attack on their own. Antiship missiles would "know" the shapes of Soviet ships and select which ones to strike.

A recent study published by the Army War College specifies dozens of uses for smart robots on twenty-first-century battlefields. Because of high manpower costs and declining birthrates, the report says, robots will be needed, particularly on certain high-risk missions. Robotic "point men" could detect booby traps or ambushes and warn human soldiers following behind. Robotic tanks could roam the battlefield locating or planting mines. According to the study, "They [robotic systems] could operate uninhibited in nuclear, biological or chemical environments." Finally, "One . . . area in which robotic-artificial intelligence could have potential application lies in the strategic warning, trans-nuclear and post-nuclear strike periods. During these periods, when humans will be under considerable emotional stress, assistance from a robotic device which had been preprogrammed, for example, to keep track of the constitutional successors might be invaluable."

As these examples show, new technology continues to create new forms of terror. The technological arms race spirals on, adding to the danger of war by miscalculation, and diminishing rather than increasing national security. Weapons have outrun politics. The search for a degree of common security lies not in the laboratory but at the negotiating table. □

AFTERWORD

Ritual Dance of The Superpowers

RICHARD J. BARNET

The decade of the 1970s, which Richard Nixon hailed as the beginning of a "generation of peace," witnessed an extraordinary acceleration of the technological arms race, and détente had no discernible effect in curbing it. The military innovations described elsewhere in this issue were conceived, contracts let and production commenced in years when the political relations between the superpowers had greatly improved. Thus, the conventional wisdom of political science—that arms competition is an expression of political hostility and unresolved disputes, and that it can be ended only by first improving political relations—has proved to be at best a half-truth.

Why was there such an escalation of the technological arms race in the 1970s? The "scientific-technological elite," which President Eisenhower paired with the "military-industrial complex" in his 1961 farewell address, is not a sufficient explanation. It has been alive and well since World War II. Thousands of bright, creative and innovative scientists and engineers are paid well to think up imaginative ways to kill people. Not only must the weapons be designed to kill cheaply—the "productivity" of nuclear weapons makes this easy—but they must be packaged in such a way as to fascinate political leaders who must persuade voters that soaring defense budgets are necessary. The secrets of selling aging politicians gadgets to kill young men in new ways have been known for years, and the techniques have been brought up to date to kindle enthusiasm for weapons of mass destruction.

The escalation of cold war rhetoric over the last few years is more a consequence of the weapons buildup than a cause; it is impossible to generate public support for multibillion-dollar weapons systems without "scaring hell out of the country," as Senator Arthur Vandenberg advised President Truman when the first large military appropriations of the cold war were being planned. The "Soviet threat" is an indispensable component of the weapons acquisition process.

The threat is not fictitious, of course. The Soviet Union in recent years has devised enough new weapons to give political plausibility to a huge U.S. investment in the search for technological "breakthroughs." However, the Pentagon consistently exaggerates the threat of Soviet advances. Thus attempts to curb the arms race with arms agreements like SALT II that only limit the choices of technology are bound to fail because the propaganda designed to keep popular

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