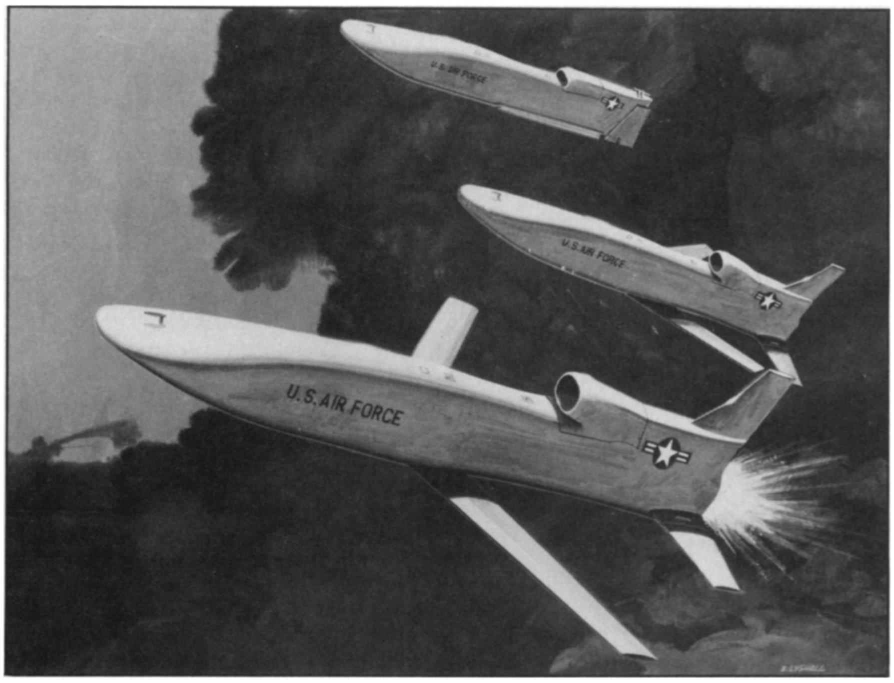
A Technology Revolution in Weaponry

The cruise missile and neutron bomb represent a new generation of technologically sophisticated weapons that blur the distinction between tactical and strategic warfare

BY JOHN H. DOUGLAS


Artist's conception: Boeing

Air Force version of cruise missile spreads its wings and ignites its jet engine.

It was Jimmy Carter the engineer and manager—rather than Carter the politician—who decided to scrap the B-1 in favor of full-speed-ahead production of the cruise missile. He refused various compromises, pushing an economical new missile technology for all it was worth, rather than making costly improvements on the manned-bomber concept. Similarly, the decision to pursue development of the neutron bomb was an engineer's choice—a gamble on technical versatility at the expense of political advantage, although he said he has not yet decided to deploy the weapon.

Together, these two decisions firmly establish the direction the administration is likely to take in its policy on military R&D, and the two weapons in question signal a revolution in the technology of warfare.

Although each device represents significant technical achievement and substantial military advantage in its own right, together they are likely to have an impact far beyond their individual potentials for destruction. By their very nature they blur the traditional distinction between strategic and tactical weaponry. Their development will stimulate a new race to produce countermeasures. And their advent has stimulated a lively debate over whether nuclear war is now more likely or less so than it was before.

Overall, American defense strategy depends on a triad of weapon families: In the event of all-out nuclear war, ICBMS from underground silos would be launched toward the full range of enemy military targets. Time from launch to impact would be less than a half hour. Should the ICBM's be destroyed, sea-launched ballistic missiles (SLBMS), with shorter ranges, would probably still be capable of a second strike, since submarines are the least vulnerable of U.S. forces. The third leg of the triad—bombers or their substitutes—are valued for their flexibility. They can be used in nuclear or conventional warfare and serve as a hedge against a first strike by an enemy, since it would be difficult to knock out both ICBMS and bombers in one sudden attack.

Each leg of the triad is now undergoing fundamental change, based on new technology. The next American ICBM—now known only as the M-X—is designed to be highly portable so that an enemy will never know just which of many possible launch sites are occupied. The first Trident submarines will enter service in 1979, capable of significantly increased speed and armed with SLBMS that can hit targets further away, with more accuracy, than those presently possible.

The third leg of the triad has long needed the greatest change. The B-52, mainstay of today's bomber squadrons, is based on the technology of the 1950s—a subsonic, high-altitude craft increasingly vulnerable to attack by the latest fighters and surface to air (SAM) missiles. For his decision, President Carter had two alternatives to improve the bomber strike force: build a supersonic, low-flying aircraft that could run under present Soviet radar (the B-1) or rely on modified B-52s and other subsonic planes to play a stand-off role, launching cruise missiles from outside enemy territory. Carter chose the latter course.

In doing so he apparently had been convinced by those who said the B-1 would be obsolete by the time it was fully deployed, since by the early 1980s Soviet radar would presumably be up to tracking low-flying bombers. Carter must also have believed supporters of the cruise missile who contend it represents the wave of the future. Malcolm R. Currie, former Director of Defense Research and Engineering, told Congress, "The advent of long range highly accurate cruise missiles is perhaps the most significant weapon development of the decade."

The cruise "missile" is really more plane than missile—a small, pilotless kamikaze bomber that hugs the ground, following an internal map, until it destroys itself within a few feet of its target. Also, because of its relatively slow speed, 500 miles an hour, it is designed to compete with conventional bombers rather than the faster ICBM's.

The secret of the cruise missile's maneuverability is a Terrain Contour Matching (TERCOM) guidance system. A radar altimeter surveys surrounding terrain as it glides along at tree-top level, comparing selected points to those on an electronic "map" stored in the tiny on-board computer. The 21-foot long bomber can thus skim the top of a mountain, turn and hug the edge of a valley, skirt a radar installation and hit its target.

But the cruise missile's versatility doesn't end there. Depending on which version one is discussing, it can be launched from air or sea, armed with a nuclear warhead or conventional explosives, and targeted against a land installation 1,500 nautical miles away or sent to search out an enemy ship 300 nautical miles away. (The main reason for the shorter range of the antiship weapon is the heavier weight of the non-nuclear warhead.)

Originally, cruise missiles were sched-

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uled for deployment sometime in 1980, but President Carter's decision is likely to speed up that timetable. The first inland flight of the Navy's Tomahawk cruise missile, developed by General Dynamics, came in March 1977. The Air Force version, Boeing's Air Launched Cruise Missile (ALCM), maneuvered along the mountainous terrain of White Sands Missile Range in May 1976 and is scheduled for full-scale engineering development this year.

The Tomahawk incorporates an additional technology that permits it to be launched from either land or sea. For the missile's turbofan jet engine to be effective, the craft must somehow be propelled to its cruising speed. If launched from the air this is a relatively easy task, but for submarine launching the missile is first propelled through the water and into the air by a solid-fuel rocket booster. The small, efficient jet engine also gives the cruise missile part of its revolutionary impact—it will be so cheap that countermeasures will have to be disproportionately expensive. Each Tomahawk is expected to cost only about $1 million in actual production, compared to $102 million apiece for the B-1 or several million dollars apiece for various ICBMS.

The technological breakthroughs that make the neutron bomb possible have not yet been revealed. Only its characteristics have been released, and those only grudgingly. (The new bomb was originally concealed under an innocuous title in the ERDA public works budget.) The device is reported to have the blast equivalent of one kiloton of TNT, but the radiation equivalent of previous 10-kiloton hydrogen bombs.

Unfortunately, some egregious misstatements have occurred in press speculation about the new weapon, adding confusion to the debate over its desirability. One syndicated columnist declared that the neutron bombs could "halt a massive Warsaw Pact thrust without even blowing down a tree," or "wipe out the defenders of a city without breaking the crockery in its china closets." Not quite. A one-kiloton blast would completely destroy buildings in the immediate area, say out to a radius of 200 yards. The point is that its enhanced flux of neutrons would spread much further, killing unprotected people to a radius of perhaps three-quarters of a mile.

Another misunderstanding arises because this is not the true "neutron bomb" physicists have been speculating about for many years. That device would contain no uranium, whose fission reaction is now used to trigger the fusion reaction in a hydrogen bomb. Since most of the radioactive "fallout" of a hydrogen bomb is caused by the atomic bomb (uranium) trigger, such a device would be almost perfectly "clean." The present device still has the uranium trigger, and is simply a *relatively* small, clean, neutron-intense hydrogen bomb. Speculation over whether a true neutron bomb could be triggered using technology from controlled fusion-energy research probably accounts for the cloak of secrecy that surrounds parts of that otherwise innocuous project.

A better way to describe the present device would be to consider it as only one type of a new generation of what have been called "mininukes." By being able to control the amount of radiation, fallout and blast from these tiny H-bombs, the Pentagon can now deploy nuclear weapons capable of performing a whole new range of tactical functions.

If a commander wanted to knock out a tank column rolling toward a town, for example, he would use the so-called neutron bomb to kill the soldiers in the tanks. (Neutrons pass through the shielding better than other forms of radiation.) The nearby town and its people would be spared. On the other hand, if he wanted to destroy an installation in the center of a city *without* killing the surrounding people, he could use a mininuke that did *not* have the enhanced radiation capability. Finally, if he wanted to make an area uninhabitable for years to come, he could use a small, "dirty" bomb.

Just how many variations of mininukes are now being produced or planned is unclear, but the argument over their inherent desirability has already been well established. Advocates claim that the miniweapons make a more "credible" defense. They say an enemy might believe that a field commander would be unwilling to use present tactical nuclear weapons against an invading tank column because they would kill so many people in the surrounding towns. Presumably the commander would be more willing to use a neutron bomb since the killing would be more localized. Only the President, of course, could *authorize* their use.

Critics of the mininukes claim that any such increase of willingness to use nuclear weapons would make all-out nuclear war more likely. Since there would be greater numbers of such weapons, and since they would be placed in the hands of other NATO countries, the critics conclude that safeguards would be diminished. Finally, critics say the slow death caused by radiation of a neutron bomb is less humane than the quicker death by the blast of previous bombs.

Both the neutron bomb and the cruise missile are likely to complicate the next round of strategic arms limitation talks (SALT) between the United States and the Soviet Union. No one is saying what the Soviet capabilities might be in making mininukes, but the Soviet Union is clearly years behind the United States in the electronics technology required for

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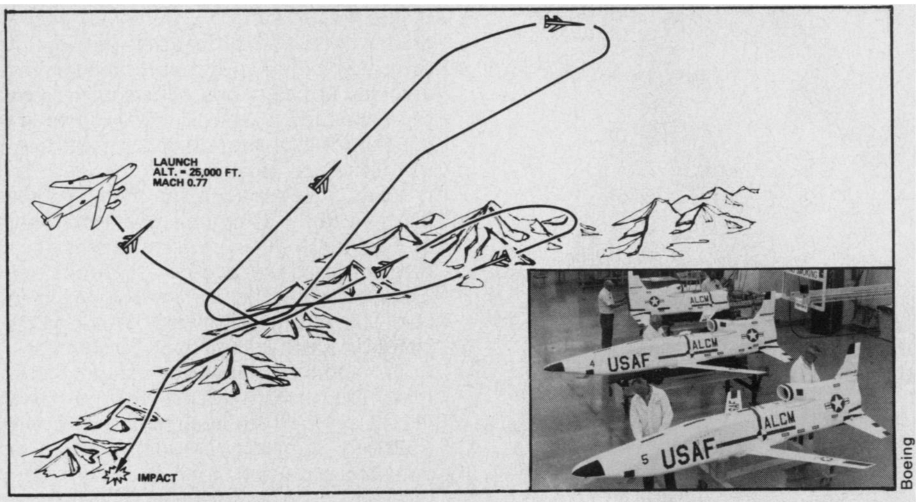

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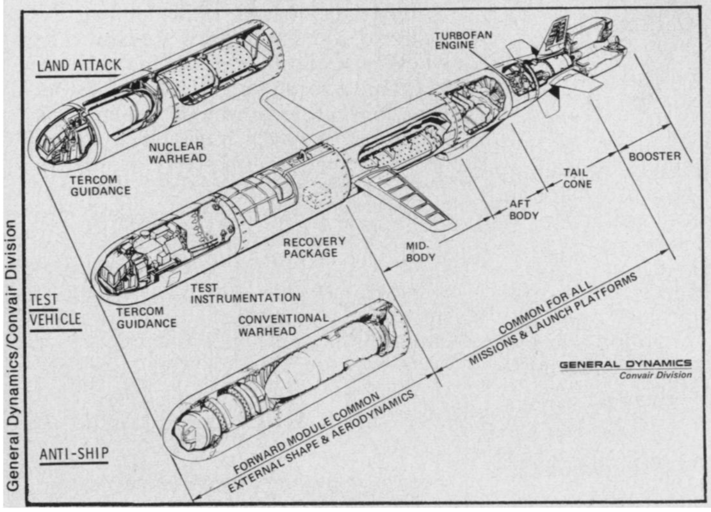

General Dynamics/Convair Division

Flight pattern of actual test run over White Sands Missile Range (above) made by Air Launched Cruise Missile (inset). Internal structure of Tomahawk (left).

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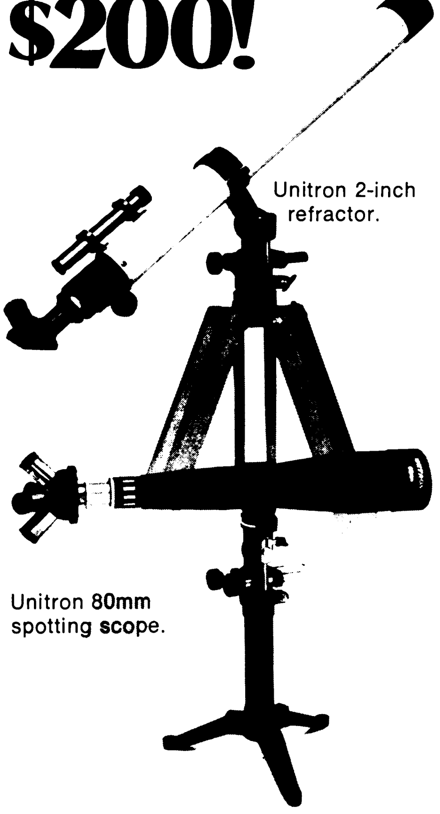

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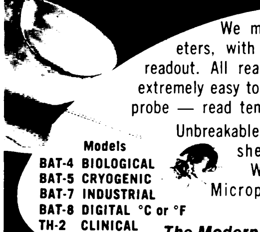
... Enkephalins

that a short amino acid sequence in the pituitary hormone MSH (melanocyte-stimulating hormone) also enhances learning by making rats negotiate a maze faster than normal. This small protein derives from a large brain protein from which the enkephalins also originate. It is called beta-lipotropin (SN: 7/2/77, p. 6). Still other beta-lipotropin-derived proteins—the endorphins—have likewise been found to exert a variety of behavioral effects in rats, both by Roger Guillemin's group at the Salk Institute in La Jolla and by Kastin and Curt A. Sandman, a psychologist at Ohio State University. One endorphin can transform angry rats into docile ones. Another makes rats anxious. A third makes rats groom. And so on. In brief, in view of the enkephalins' origin and the startling diversity of behavioral effects exerted by their chemical cousins, it is hardly amazing that one of the enkephalins at least can influence learning.

Might Met-enkephalin help people learn better? Kastin feels that it may, but as he points out, the enkephalins, like morphine, have addictive properties. Thus he would be reluctant trying it in clinical trials. Anyway, MSH exerts similarly positive effects on learning and is not addictive, and Kastin and Sandman are already achieving positive results among both healthy and mentally retarded subjects by using MSH to enhance attention and learning (SN: 9/25/76, p. 207). With Lyle H. Miller of Temple University in Philadelphia, they will also soon undertake studies to see whether MSH can improve the attention span and learning abilities of older people and whether a more potent analog of MSH might be even more effective than MSH in helping the mentally retarded.

Nonetheless, the use of Met-enkephalin as a human behavioral drug has not been altogether ruled out. And even if it is never used clinically to enhance learning, its behavioral effects represent another exciting discovery about the brain's small proteins. □



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... Weapons

long-range cruise missiles. Not surprisingly, the Russian press and official spokesmen have roundly condemned both new weapons.

Even within the U.S. government there seems to be disagreement over the likely impact of the weapons. The Pentagon argues that both weapons will not only add new capability and versatility to the U.S. arsenal but also force the Soviet Union to divert large amounts of funds from offensive to defensive projects. To counter the cruise missile would require years of R&D in radar and missile technology, and to shield tanks against neutron radiation would also require a massive effort. Disarmament specialists contend that introducing such new weapons now will only make the Russians less conciliatory in the forthcoming SALT talks.

Whatever the outcome of this debate, another fundamental change in potential warfare has clearly resulted from technological progress. The cruise missile is a logical, perhaps inevitable, product of large-scale integration of electronic circuitry. Although technical details remain classified, the mininuke is probably an equally logical extension of the basic research that may someday solve the world's energy problems through controlled fusion. During the 30 years that have passed since the first military use of atomic energy, scientists have been proclaiming how much they want to have a voice in how their discoveries are put to use. Now another technological weapons revolution is shaping up, challenging that resolution more perhaps than at any other time since Hiroshima. □

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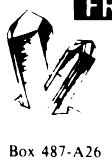

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