

## Military R&D: Technology on the march

In the newly issued Federal research and development budget for fiscal 1977 (SN: 1/24/76, p. 52), \$11 billion, not quite half the total, is devoted to military programs. The appearance before Congress last week of Malcolm R. Currie, the Director of Defense Research and Engineering for the Department of Defense, offered insight into the major projects being emphasized, as well as a carefully veiled glimpse of some awesome new technologies for future weapons systems.

The \$11 billion budget request represents a seven percent increase over present funding, but falls \$1 billion short of what Currie called "a fully justifiable program." Overall R&D investment has fallen proportionally in recent years to some 30 percent of the defense budget, he said, but the proposed expenditures for fiscal year 1977 would reverse that trend. If current trends are not reversed, Currie warned, "The Soviet Union can achieve dominance in deployed military technology in the 1980's." He said the Soviet Union leads in several vital defense areas, including strategic air defense systems, antiship missiles, chemical warfare and some areas of research into high-energy laser systems.

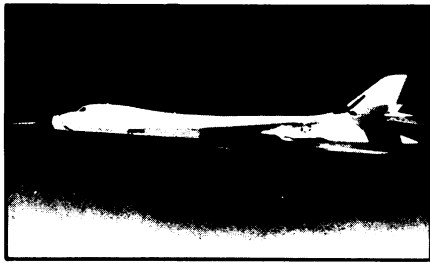
In response, the United States has several new major military systems emerging through the R&D process:

- The M-X advanced intercontinental ballistic missile (ICBM). The M-X is designed to counter a perceived Soviet threat of being able to knock out present-type ICBM's in their silos in the 1980's. The M-X (budgeted for \$84 million) could carry heavier payloads with greater accuracy, but more important, it could be transported horizontally from place to place for erection and launching from undetected sites.

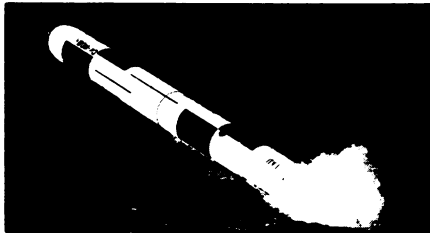
- The cruise missile. Already a controversial topic in the disarmament negotiations (SN: 12/13/75, p. 376), the missile can be launched from a bomber or a naval vessel. Taking advantage of U.S. technological superiority in guidance and propulsion techniques, it can streak along at low altitudes following local terrain with an on-board computer. The air-launched version (budgeted for \$79.2 million) is scheduled for first powered flight later this month; the sea-launched version (\$182.5 million), for flight in May.

- The B-1 bomber. A prototype is flying, but so is the fur—critics call it a flying white elephant that will be obsolete when it goes into service (in the 1980's). Costs have skyrocketed (the budget request this year is \$482.7 million). Proponents emphasize the increased probability of penetration into enemy territory because of a multitude of sophisticated defense systems.

- The space shuttle. The National



B-1 bomber prototype: The fur is flying.



Cruise missile: Low-altitude streaker.

Aeronautic and Space Administration is in charge of building the shuttle, which should have its first operational flights in 1980. But the Defense Department is preparing to use it to help launch a variety of military satellites and "explore ways in which man can contribute in the far term to the effectiveness of military space systems." Total shuttle-related military expenditures through FY 1981 are expected to be \$1.45 billion, with the option for another \$700 million to modify equipment at Vandenberg Air Force Base to launch the shuttle from there (the optimal site for launches into polar orbit).

- The NAVSTAR system of satellites for navigation. By 1980, 12 navigational satellites are planned, with a dozen more to follow over the next few years. The system (current request \$78.5 million) is supposed to enhance capability in missile guidance, blind bombing, troop move-

ment and routine navigation.

Currie's testimony also revealed the state of several new technologies that may soon find their way into practical weapons systems:

- Lasers. A major problem has been how to deflect or steer laser beams; recent experiments have demonstrated a way of doing this with high pressure gas streams. One of the more intriguing changes for bureaucracy-watchers was an announced shift of responsibility for coordinating the entire laser weapons project directly to Currie's office, where an Assistant Director will oversee active projects now being pursued by all three armed forces (to the tune of \$187 million this year—up 20 percent).

- New goggles that allow foot soldiers to see at night without artificial illumination have been demonstrated (earlier systems were too bulky).

- A low-volume ramjet engine was tested in full-scale flight, opening up "a new era in missile propulsion," with faster speeds and greater ranges.

- Remotely piloted vehicles are now equipped with imaging systems and lasers to provide reconnaissance information and laser direction for a new generation of "guided projectiles."

- New ceramics for gas turbines may increase fuel efficiency by 25 percent and double the maintenance-free lifetime of such turbines.

- New sensors for satellites will allow background suppression and contrast enhancement of ground images to be done on-board before relaying the pictures to a commander; concept feasibility was demonstrated last year.

- SEAGUARD—an acoustic system that can listen to sounds made underwater *thousands* of miles away, discriminate them from background and provide location of the source.

- "Speculative projects" like X-ray lasers; Currie didn't elaborate. □

## Concorde trial gets DOT approval

In what is likely to be one of the most important steps in the development of commercial transportation by supersonic aircraft, U.S. Secretary of Transportation William T. Coleman Jr. last week opened the door to the Concorde. It is only for a temporary period—16 months of commercial operation, to encompass all four seasons plus four months more for "data analysis." But the decision was hailed by proponents of the Anglo-French SST, some of whom described the trial period as being even longer than they had expected. Environmentalists were far less pleased.

Coleman's decision allows as many as six SST flights per day to land in the United States: two each by British Airways and Air France at New York's John F. Kennedy Airport and one each at Dulles Airport in Virginia. Landings and takeoffs on



The Concorde landing at Dulles in 1973.

the United States end must take place between 7 a.m. and 10 p.m. local time, and the Concorde still may not fly at supersonic speeds over U.S. territory.

Coleman ordered the Federal Aviation Administration to monitor noise and emission levels at both airports throughout the trial period, but he also cited the environmental impact statement prepared by the FAA in declaring that during the test, air quality effects would be "negligible," climatic effects "clearly insignificant" and low-frequency noise "not a serious objection."

His decision, however, does not fully resolve the matter, even for the test period. Environmentalist forces have threatened legal action to block the decision in the courts. In addition, while Dulles is a federally operated airport and thus under Coleman's direct jurisdiction, Kennedy is operated by the Port Authority of New York and New Jersey, which has yet to add its necessary permission. If the JFK go-ahead is withheld, says Coleman, "... that would obviously be extremely unfortunate and would greatly diminish, but in my opinion it would not destroy, the validity of the demonstration."

One possible concern that Coleman admitted was not part of his deliberations was whether the Concorde might "skim the cream" off the already troubled transatlantic market. Matters of competition, he said, are concerns of the Civil Aeronautics Board. □

## Magnetic turtle points the way

Civilizations flourished in Mesoamerica long before Columbus set sail. Exactly where and when Central American civilization got its start is still a mystery, but clues have been found. The highly complex and precise 260-day calendar of the Mayas, for instance, may have originated in Izapa, an ancient ceremonial center on the Pacific coastal plain of southern Mexico. Evidence for this theory was put forward in 1973 by Vincent H. Malmstrom of Dartmouth College. Now he reports another bit of circumstantial evidence that again points to Izapa as the cradle of civilization in the New World.

The evidence is a stone sculpture that depicts the head of a turtle. While examining astronomical alignments of various structures at Izapa, Malmstrom put his compass near the turtle head and noticed a sharp deflection of more than 60 degrees. No matter where the compass was placed along the perimeter of the sculpture, the needle continuously pointed to the snout of the turtle. No other stones or sculptures in the area were found to have magnetic properties. "This would suggest," says Malmstrom in the Feb. 5 NATURE, "that the Izapans knew about magnetism in that they had reserved a

basaltic boulder rich in iron ore for their carving of the turtle head, and had executed it so carefully that the magnetic lines of force all came to a focus in the snout of the turtle."

Why a turtle? Clearly, says Malmstrom, the Izapans, a sea-faring people, were impressed by the navigational and homing abilities of the sea turtles common to the area. Whether or not they applied their knowledge of magnetism to navigation or to anything else is unknown, but later Mesoamerican civilizations did.

Malmstrom believes the magnetic turtle to be about 3,300 years old. A hand-worked piece of magnetized iron ore

thought to be about 3,000 years old was discovered at an Olmec site (SN: 9/6/75, p. 148). And the later Mayan civilization, which was influenced by the Olmecs, appears to have made extensive use of magnetism in the alignment of their cities. Many run along an axis that is 17 degrees east of north, indicating that a magnetic compass was used.

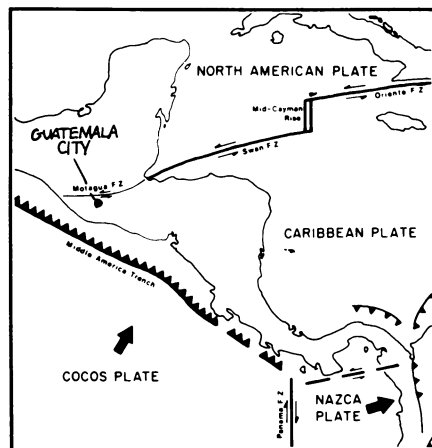
If Malmstrom's theory of cultural diffusion in Mesoamerica is correct, the Izapans were the originators of at least two important ideas—the 260-day calendar and magnetism—and Izapa can be considered the cultural hearth of the New World. □

## Guatemala quake: Plate-triggered



Guatemalan disaster is marked by flattened homes in Patzicia near Guatemala City.

In 1773, when a major earthquake devastated Guatemala's then-capital of Antigua, planners decided to relocate the capital on what appeared to be safer ground: a vast tableland, the present site of Guatemala City. The safer ground was dealt a major blow by another quake in 1917, another in 1942. The latest, which struck on Feb. 4, measured 7.5 on the Richter scale and took a catastrophic toll estimated as high as 25,000 lives, with still more injured and homeless.



Motagua fault follows plate boundary.

Guatemala City lies scarcely 10 miles north of a chain of volcanoes, many of them active, extending from Mexico down through Guatemala, Honduras, Nicaragua and Costa Rica. It also sits vulnerably atop an insecure footing of thick layers of relatively loose-packed volcanic debris, close to the Motagua fault zone. But the underlying cause of the Feb. 4 quake, a group of U.S. Geological Survey scientists believe, is more deep-seated still.

The Motagua fault zone, which apparently includes the epicenter of the quake (120 miles northeast of Guatemala City), lies on or near the boundary between the North American and Caribbean plates, two of the great crustal plates that move slowly but inexorably over the mantle of the earth. The USGS researchers, Charles Knudson and George Plafker from Menlo Park, Calif., and Alvaro Espinosa and Raul Husid from Denver, together with Karl Steinbrugge of the University of California at Berkeley, believe that the grinding of the plates against each other may have ruptured the fault much as similar plate motions have caused major quakes along the San Andreas and related faults in California. The team is now in Guatemala, studying the area at that country's request. □