couple's physical and emotional investment in the child, make adultery seem less heinous (perhaps even more natural), and foster a "stud-farming mentality."

McCormick says the general wisdom of the Church in these matters is more interesting to him than the "knock-down arguments" on specific issues. In dealing with new reproduction technologies, McCormick's greatest concern is that Americans are developing a consumer attitude toward children. He imagines a couple sometime in the future walking into a hatching center to choose their child's eye and hair color, sex, height, and so on. "Some people already talk about the right to have a healthy child. Maybe soon we'll hear about the right to have a smart child." The attitude is disturbing, McCormick thinks, because it signals a profound change in the way people regard childbearing. A steely utilitarianism is creeping into an act that should be based on simple love.

"It is easy to see how we have depersonalized the dying process," McCormick says. "We isolate the patient behind a wall of tubes and medical equipment" in an attempt to conceal the human agony of death. Is it not possible that childbearing could become just as dehumanized? McCormick's overriding concern is to see that people remain the master of technology in medicine in all circumstances—from childbearing to dying—and that the mechanization of human functions be held to a manageable level.—ELIOT MARSHALL

High-Cost Lemons in the U.S. Arsenal

Experts suggest that current weapons flaws are caused by technological overcomplexity and the absence of industrial competition

The Navy has equipped each of its most advanced ships with a sophisticated radar system that tracks several targets at once and automatically fires the ship's weapons. But it works only 60 percent of the time, because of random failures of its 40,000 parts. The rest of the time, the ships are virtually defenseless.

The Air Force has developed a jet fighter, the F-15, that flies faster and better than any other jet fighter in the world. But it sits on the ground a lot, because of engine troubles and a shortage of spare parts. The Air Force says that only about 60 percent of its F-15's are capable of flying a real mission at any time.

The Army's tank-killing helicopter, the Cobra, uses highly effective guided missiles that each cost $6700. But the system that fires and targets these missiles breaks down repeatedly, causing the missile to veer in the wrong direction. The rotor on the helicopter itself frequently breaks down because of faulty bearings.

On the eve of a major buildup in weapons procurement by the Reagan Administration, several recent reports are calling attention to the Pentagon's current practice of buying costly arms that fall dramatically short of expectations. Shoddy workmanship, skyrocketing costs, and unreliable operation characterize many current weapons programs. Prospective costs of the 47 largest programs rose by $48 billion just between October 1980 and 1 January, only partly because of inflation.

The government now buys fewer, more complicated items that ultimately need expensive redesign and the sort of care and maintenance that is impractical in wartime. The Department of Defense (DOD) will soon spend millions of dollars, for example, to repair some submarines, including the Trident, and some M1 Army tanks, in use for about a year. (The submarines have unsatisfactory welds and the tanks have drive train problems.) The cost of the M1 has more than doubled in the last 5 years, to about $2.6 million for each tank. A recent report by the General Accounting Office (GAO) offers the following examples of problems with other current weapons systems: "a tank hatch that a soldier, clothed for winter, cannot fit through; aircraft test equipment that causes more problems than it solves; and a handheld missile that, when fired, startles the person that fires it, resulting in misses."

So numerous are the deficiencies in current weapons programs that most observers now realize the situation is not susceptible to short-term solutions. The Reagan Administration, while boosting defense procurement by $20 billion, or 40 percent, has promised to examine the process from top to bottom. The review is to be directed by Frank Carlucci, the undersecretary of defense. Responding to complaints that most weapons contracts are filled by large firms with little incentive to keep costs low, Defense Secretary Caspar Weinberger says that "we will have to strengthen and revitalize our industrial base, and this will produce significant cost-savings." Meanwhile, the House Appropriations Committee has appointed a special panel to examine defense procurement and to examine whether weapons are now so complex that they frustrate all attempts at reasonable operation.

There will be plenty to study. In addition to defects in the weapons already mentioned, maintenance and operations problems have beset a major Army self-propelled howitzer, the Air Force plane designed to attack submarines, and the existing Army M60 tank. Huge cost overruns have hit a number of new weapons programs, including an Air Force laser-guided missile, a sophisticated antisubmarine system, the Navy F/A-18 attack plane, and the new Army Blackhawk helicopter. Each incorporates state-of-the-art military technology.

There are almost as many schools of thought about what to do as there are faulty armaments. The prevailing view at the Pentagon has for years been that any deficiencies in battlefield weaponry are primarily deficiencies of supply—that Congress has not supplied enough money to design the weapons correctly or to purchase the required number of spare parts. Meager budgets since the close of the Vietnam War have forced the military services to concentrate on modernization at the expense of readiness to fight—a phrase that translates as purchasing new weapons while paying insufficient attention to what it takes to keep them operating. Major General John T. Chain, Jr., the director of operations and readiness for the Air Force, told *Science*

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that "there is one reason for our current problems with readiness and sustainability: a lack of appropriate funding for the last ten years." He estimates that $17.6 billion for spare parts and munitions, plus some additional money for repair technicians, will resolve the Air Force's equipment troubles.

This view is shared, to some extent, by the Reagan Administration, which considers readiness to be the hottest topic in the ever-changing cycle of defense priorities. Reagan intends to buy the same weapons and supporting equipment that former President Carter did, but more quickly and in far greater quantities. Officials say that having more equipment around will make the failure of individual items less worrisome; technicians can, among other things, more easily cannibalize spare parts from working units, a common practice among crews tending the F-15. And the costs of specific weapons may decline as a result of accelerated production schedules, even if the total cost of each system is much higher. Under the Carter budget, for example, the Navy was to build two EA6B radar-jamming aircraft at a cost of $60 million apiece. Reagan plans to build six, and the resultant production economies dropped the individual cost to less than $30 million. In this manner has the initial battle against expensive, unreliable weaponry been joined.

Increasingly, experts believe that more systematic changes in the defense procurement system may be necessary. One view holds that weapons are just too complex, and that the only solution is to strive for greater simplicity. The most cogent statement of this view has emerged from within the Defense Department, of all places. Franklin Spinney, a DOD program analyst and former Air Force engineer, recently told a Senate subcommittee that the military's pursuit of technological sophistication at any cost has caused it to ignore human contributions that account for numerous weapons failures. In a report that prompts criticism from other Pentagon officials, Spinney writes that "our bias toward short-term investments in weapons of increasing complexity is the cause of our long-term cost growth."

Pentagon planners are repeatedly seduced by the notion that "advancing technology will . . . provide revolutionary increases in capability," Spinney says. Actual combat experience is disappointing, either because capabilities are exaggerated during a weapon's design or because the advantage offered by new technology proves to be slight. This was

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Identifying the Dangerous Individual

If the Secret Service had interviewed John Hinckley before his alleged attempt to assassinate President Reagan, would he have been identified as potentially dangerous?

Even before the latest assassination attempt, the agency was worried about its methods for identifying people who pose a danger to its "protectees." Last September the Secret Service asked the Institute of Medicine (IOM) to review the literature on violence-prone individuals and come up with some recommendations to improve its screening system. The committee of lawyers and behavioral scientists, headed by Walter Menninger of the Menninger Clinic, held a 2-day workshop in early March. Its report is due in July.

The committee has a difficult task, because it is well known that the best—and perhaps only—predictor of violence on the part of an individual is past acts of violence. Asked what sort of research might yield other indicators, committee member Elissa Benedek of the University of Michigan suggested that "we can begin to look at particular diagnostic categories of mental illness where there is more likelihood" of dangerous behavior. But she emphasized that this might result in only marginal gains in understanding since the vast majority of mentally ill persons are not dangerous.

Secret Service spokesmen told *Science* their organization used to be guided by an assassin's profile of sorts, which was a composite of Bremer and Oswald types—that is, the lone, maladjusted young male. But then Squeaky Fromme and Sara Jane Moore, the two women who tried to shoot President Ford, blew that away. The agency keeps a list of about 350 individuals who are regarded as definitely dangerous, and whose whereabouts it likes to know—an easy task because the vast majority are institutionalized. The primary way suspicious characters are identified is through threatening letters to the protectees. Every time the Service hears about such threats, voiced or written, they track down the perpetrator for an interview. If an individual seems unbalanced, he is asked to undergo a psychiatric evaluation. Current procedures, however, appear to be inadequate. Secret Service spokesman Jim Boyle suggests that there "may be some way that therapy can be arranged" for violent loners who write threatening letters to the President.

IOM committee member Saleem Shah, who heads the National Institute of Mental Health's Center for the Study of Crime and Delinquency, says that the base rate of political assassinations is so low that experts can never expect to achieve success in predicting likely assassins. Officials have little more to go on than they did in 1969, when the National Commission on the Causes and Prevention of Violence came up with the following list of attributes of presidential assassins and would-be assassins: male, white, foreign-born or with foreign-born parents, slight of stature, loners who can't hold a job or maintain a relationship. Typically, they come from broken homes with absent or unresponsive fathers, zealously adhere to some cause, use a handgun for the murder attempt, and select a moment when the President is appearing before a crowd, thus making their act very public and virtually assuring their own apprehension. That Hinckley fits some of these categories and was still able to do what he did, emphasizes the difficulty of the Secret Service's task.—***Constance Holden***

FDA, NHTSA Appointments

The Reagan Administration has made several recent appointments of interest to the scientific and medical community.

Arthur Hayes, Jr., a physician and expert in the therapeutic uses of drugs, has been nominated as director of the Food and Drug Administration (FDA). Hayes, 47, currently teaches at the Pennsylvania State University Hershey Medical Center, where he specializes in research on drugs to treat hypertension. He is the immediate past president of the American Society for Clinical Pharmacology and Therapeutics.

Hayes's background seems well suited to the tasks he will confront. He has a masters degree in politics, philosophy, and economics, earned at

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the case with the Air Force F-4 fighter and the Sparrow air-to-air missile during the war in Vietnam, he says. Complicated weapons require a lot of testing, yet "as weapons get more expensive, we tend to fire them less—and less realistically—in training and testing." Consequently, false assumptions about weapons' capabilities often go unchallenged.

Spinney says that defense officials also naïvely believe that complexity can be offset by designing weapons for ease of maintenance. A particularly instructive example is provided by the F-15, which incorporates state-of-the-art electronics for weapons guidance and navigation. The electronics are arranged in "black boxes" for easy removal and replacement in the event of failure. But diagnosis of a problem is initially made by a computer onboard the plane that is prone to mistaken judgment. Testing and repair equipment at the base frequently breaks down; properly trained repairmen are scarce; and not enough replacement parts are stored. As a result, the maintenance record of the F-15 is about four times worse than was expected during its design and initial production. Breakdowns are so frequent that the Air Force must have about nine of the $21.5 million planes on hand for every five it may actually need.

The GAO, in its recent report,* bemoans the fact that logistical problems have "had little or no impact on [weapons] system design." Practical combat requirements are too often ignored or overlooked. Spinney notes that much of the recent cost growth in jet fighters stems from electronics improvements enabling a pilot to shoot down an enemy plane in all weather, while still out of sight. There is, however, no sure way of determining whether a plane that is out of sight is friend or foe—such a system "has defied development for years and is still only projected to exist," Spinney says. Hence, the ability to fire at long range becomes useful only if the allegiance of the target is essentially immaterial. As a result, the pilots of planes in Vietnam that possessed this ability were ordered not to fire until they had made a positive identification by sight.

Advocates of less sophisticated weaponry are in the minority at the Pentagon. Major General Chain says that Spinney's report is the product of "a very limited density of experience." Senator John Tower (R–Tex.), chairman of the Armed Services Committee, believes that any move away from technological sophistication is "ridiculous." Pentagon officials and congressional aides alike repeat the claim that technology improvements are dictated by similar advances made by the Soviets. "They're the ones who are running into trouble because their weapons are too complex," says one congressional aide.

> "If there were two procurement sources, the military wouldn't have to tell each one how to solder."

But less sweeping reforms of the procurement process have attracted more interest. Several experts say that letting two contractors build each weapon, instead of just one, will improve quality and reduce costs. Less than 40 percent of defense procurement is formally considered competitive, and even then it is typically for rights to an exclusive contract. "The military argues that the F-15 and the F-16 were competitively produced, because they can remember when there was a design competition fifteen or twenty years ago," says Jacques Gansler, a former deputy assistant secretary for procurement and assistant director of defense research and engineering.

Gansler, who is currently a defense consultant and the author of a recent book, *The Defense Industry*,* says that the military should never become dependent on a sole supplier. When it does, the firm has a tremendous incentive to "buy in" by making a low initial bid, and later find ways to get the contract changed. Because profits are frequently allocated as a percentage of a contractor's costs, the firm "is in a position to go to the government with 'explanations' of 'government-induced' problems that are increasing costs, causing delivery delays, and so forth, and to bargain for additional prices," Gansler says. Recent federal negotiations with the manufacturer of the troubled F-15 engine illustrate the value of competitive production. The Air Force, acting at congressional direction, threatened to hand the contract to another firm and, as a result, the initial maker, Pratt & Whitney, corrected many of the engines' flaws and offered a warranty for repairs.

Gansler says that competitive pressures would also eliminate the need for so much federal supervision. "If there were two procurement sources, the military wouldn't have to tell each one how to solder," he says. The idea has garnered some support at the Congressional Budget Office, which estimated in January that needless military procurement regulations add between 20 and 100 percent to the cost of a weapons system.

A side benefit of competitive production is that it would spread weapons contracting benefits among a larger number of firms, Gansler says. The high cost and increasing complexity of weapons has favored large companies, with the result that only 25 firms hold 50 percent of all defense contracts, and only 8 firms conduct 45 percent of all defense research. More than 2000 aerospace industry subcontractors disappeared from 1968 to 1975, many of them unique suppliers of critical defense components. Spreading the contracts around would stabilize the industry and reduce the military's dependence on the fortunes of only a few.

Industry officials say that red tape and high start-up costs diminish their interest in weapons programs. But multiyear contracting, wherein the Defense Department agrees to buy weapons for more than just 1 year at a time, would reduce the risks that small firms incur when they invest in research and complicated production machinery. The Air Force has proposed to grant long-term contracts on six existing programs, although none involve small manufacturers. Still, the GAO estimates that savings of at least $12 billion would result from contract renegotiations.

The problem of costly and flawed weapons is not a simple one, and no single solution seems likely to work. Despite initial stirrings of interest, defense officials remain largely unconvinced that either technological simplicity or competitive production will significantly improve the military's readiness or capabilities. The long-held view has been that more money—by itself—will solve any weapons troubles, and in the current Washington climate, few seem likely to move from this position.

—R. JEFFREY SMITH

*"Effectiveness of U.S. Forces Can Be Increased Through Improved Weapon System Design" (General Accounting Office, Washington, D.C., 1981).

*J. Gansler, *The Defense Industry* (MIT Press, Cambridge, Mass., 1980).