August that simply launching Phase I might run as high as $32 billion, not counting the cost of R&D and manufacturing the system, and that deployment of additional phases later on could put the bill up to $1 trillion. The CRS projections vary widely because the launch cost could drop from the current $3000–5000 per pound to something like $400 per pound for low-Earth orbit and from $18 000 to $3000 for geosynchronous orbit if an advanced heavy-lift system is developed.

Evolution. The Pentagon task force, like the APS panel, supported continued research on SDI. Asked to review the prospects of proposed space-based interceptors, the Everett panel evaluated such matters as systems design, cost estimates, development schedules and "milestone decisions." Its report cautions that defensive systems are never built to an immutable architecture. "Enemy reactions, new technology and changing requirements all lead to continual evolution," it says. "The plan to build SDI in phases is therefore reasonable and customary."

Before Weinberger, Abrahamson and other Phase I cheerleaders can find comfort in that statement, however, the Everett panel goes on to warn that none of the current cost estimates are reliable, "even assuming that the current Phase I concept holds. By the time the necessary system and underlying technology work is complete, the design may change considerably and costs change as well. There are also sizable uncertainties in such matters as learning curves for space hardware produced in modest quantities, launch costs and production costs for ir focal planes and hardened high-speed data processing." As for scheduling deployment in 1994 or thereabouts, the panel observes, Congressional support is so uncertain that anything said now is not likely to hold up.

One section addressing milestone decisions that have to be made by the Defense Acquisition Board was deleted from some versions of the panel report. That section was deleted, according to one of the panel's members, because there was no way of evaluating the gaps in either the current design or the key technologies to enable the Joint Chiefs to be sure that the system would meet their requirements. However, an earlier draft of this section appears in the version that Congressman Olin placed in the *Record*.

Defiance. The report provides additional ammunition to members of Congress who would like to zap or cap the SDI budget. Though a Defense appropriations bill is unlikely to be passed before fiscal 1988 begins on 1 October, the House and Senate have both indicated where they stand on SDI. The House voted to reduce President Reagan's request for $5.9 billion to $3.1 billion, which is more than $600 million below SDI's current account. In the Senate, the Armed Services Committee recommended $4.5 billion. Senate Democrats are holding the entire military budget hostage to SDI—in open defiance of Reagan and, surprisingly, public opinion. Polls have shown that between 60% and 82% (depending on the way questions are asked) of the US public favors developing the President's vision of a missile shield.

The Pentagon, meanwhile, operating on the strategy that the best defense is an offense, released the first formal description of Phase I, presumably now given the official title of Strategic Defense System—1. Like the Everett report, SDS-1, contained in a document 2 inches thick, was issued for use by the Defense Science Board and Defense Acquisition Board. It calls for at least 13 major tests of six different systems, including a space-based interceptor rocket, sensor satellites and a communications network, over the next five years. The experiments would provide the first glimpse of technologies needed for a low-tech Star Wars, and all are designed to comply with the "narrow" or traditional interpretation of the 1972 US–Soviet Antiballistic Missile Treaty.

None of the tests involve the exotic laser or particle beams that the public mind usually associates with Star Wars. More than half of the proposed space experiments for SDS-1 would consist of attempts to intercept missiles in flight using infrared guidance to direct a small rocket, sometimes called a "smart rock." Two tests would involve launching state-of-the-art satellites to detect and track missiles in their boost and post-boost phases.

The SDS document covers the environmental effects of testing on 15 DOD sites, including the Kwajalein Atoll in the Pacific.

—Irwin Goodwin

Supreme Court bars creationism in schools

In a setback for religious fundamentalism, the US Supreme Court overturned on 19 June the 1981 Louisiana law requiring that "creation science," the Bible's account of the origins of life, must be taught in public schools whenever the concept of evolution comes into the curriculum. By a 7–2 decision, the court agreed with two lower courts that Louisiana's Balanced Treatment Act violates the First Amendment to the Constitution, which forbids government from making any law that endorses the "establishment of religion"—a precept that has been construed traditionally as meaning that government at all levels has no business promoting religion in classrooms or anywhere alse.

Writing for the majority, Justice William J. Brennan Jr, the senior member of the court, called the Louisiana legislature's claim that the law had the secular purpose of "protecting academic freedom" simply a "sham." Brennan's 17-page opinion states that "The preeminent purpose of the Louisiana legislature was clearly to advance the religious viewpoint that a supernatural being created humankind." Brennan's prose is precise: The law's "primary purpose was to change the science curriculum of the public schools in order to provide persuasive advantage to a particular religious doctrine that rejects the factual basis of evolution in its entirety."

New strategy. The Supreme Court's ruling culminates a six-year legal battle that began when the Louisiana legislature passed the Balanced Treatment Act in July 1981—though the law was never carried out because it was immediately challenged in the courts. Ironically, the legislation had been carefully crafted as a strategy to avoid the constitutional problems that defeated somewhat similar laws in Arkansas and Mississippi in recent years. It did not mention God or religion and plainly required the teaching of information that it termed "scientific evidences," which included passages from Genesis, alongside the body of knowledge known as evolution. The Balanced Treatment Act required that evolution be taught "as theory, rather than as proven scientific fact" (PHYSICS TODAY, February 1987, page 64).

Brennan's opinion in *Edwards v. Aguillard* (Case No. 85-1513) is extraordinarily clear about the issue: "If the Louisiana legislature's purpose was solely to maximize the comprehensiveness and effectiveness of science instruction, it would have encouraged teaching of all scientific theories about the origins of humankind. But under the act's requirements, teachers who

were once free to teach any and all facets of this subject are now unable to do so. Moreover, the act fails even to ensure that creation science will be taught, but instead requires the teaching of this theory only when the theory of evolution is taught. Thus we agree with the Court of Appeals conclusion that the act does not serve to protect academic freedom, but has the distinctly different purpose of discrediting 'evolution by counterbalancing its teaching at every turn with the teaching of creation science.' "

Few issues are more vexing to judges and lawyers than the separation of church and state as formulated in the Constitution. Justice Lewis F. Powell Jr, who frequently takes pivotal positions on social and political questions before the court, issued a singular opinion on the case. "Even though I find Louisiana's Balanced Treatment Act unconstitutional," he wrote, "I adhere to the view [put forward in *Board of Education v. Pico*, a 1982 decision from which Powell dissented] 'that the states and locally elected school boards should have the responsibility for determining the educational policy of the public schools.' . . . In the context of a challenge under the Establishment clause, interference with the decisions of these authorities is warranted only when the purpose for their decisions is clearly religious."

Theistic tradition. Powell, who resigned from the court a week after the Louisiana creationism decision, went on to deliver an *obiter dictum*: "As a matter of history, schoolchildren can and should properly be informed of all aspects of this nation's religious heritage. I would see no constitutional problem if schoolchildren were taught the nature of the Founding Fathers' religious beliefs and how these beliefs affected the attitudes of the times and the structure of our government. Courses in comparative religion of course are customary and constitutionally appropriate. In fact, since religion permeates our history, a familiarity with the nature of religious beliefs is necessary to understand many historical as well as contemporary events." In the Louisiana case, though, Powell concluded, "The language and legislative history of the Balanced Treatment Act unquestionably demonstrate that its purpose is to advance a particular religious belief."

The court's newest member, Antonin Scalia, delivered a withering 31-page dissent, protesting that there is no proof Louisiana's lawmakers had religion in mind when they paired creationism with evolution in the curriculum. "We have no basis on the record to conclude that creation science need be anything other than a collection of scientific data supporting the theory that life abruptly appeared on Earth," Scalia wrote. The majority opinion, he argued, is an "illiberal judgment," which he found "repressive" of Christian fundamentalism. Scalia's dissent, joined by Chief Justice William H. Rehnquist, rejected the body of the court's recent rulings, which holds that a law may be struck down on the basis of the motivation for its passage. People in Louisiana, Scalia argued, "are quite entitled, as a secular matter, to have whatever scientific evidence there may be against evolution presented in their schools." He called the decision "*Scopes* in reverse"—an allusion to the famous 1925 "monkey trial" in which a Tennessee schoolteacher, John Scopes, was convicted and fined $100 for teaching Darwin's theory of evolution in violation of a state law.

The central issue for the Louisiana legislature in enacting the law, claimed Scalia, was academic freedom—"to ensure that students would be free to decide for themselves how life began, based on a fair and balanced presentation of the scientific evidence." Scalia concluded, "on the evidence presented in this case . . . we cannot say . . . that the scientific evidence of 'creation science' is a body of scientific knowledge rather than revealed belief. Infinitely less can we say (or should we say) that the scientific evidence for evolution is so conclusive that no one could be gullible enough to believe that there is any real scientific evidence to the contrary."

Textbook brouhaha. While the Supreme Court's decision is another blow to efforts to introduce religion in classrooms through state laws, it is not expected to quell disputes over the content and choice of textbooks. Despite the uniqueness of the Louisiana law, some civil liberties lawyers claim there are similarities between that state's attempts to promote creationism and efforts by parents in Alabama and Tennessee to change school programs that they insist clash with their religious views.

In a case brought in Mobile, Alabama, a Federal judge ruled last March that 44 textbooks should be removed from schools because they champion "secular humanism," which fundamentalists say violates their religious beliefs. Another case, pending appeal in Tennessee, rests on a decision last October that children of fundamentalists must be excused from reading books that their parents opposed. Among the books: *The Wizard of Oz* and Anne Frank's *Diary of a Young Girl*. —Irwin Goodwin

O'Neill leaves SDI after Senate dust-up

In July Brigadier General Malcolm O'Neill left the Strategic Defense Initiative, where he had been deputy director of programs and systems, to become commanding officer of the Army Laboratory Command in Adelphi, Maryland. Possibly by coincidence, the Pentagon's announcement of O'Neill's departure came four days after he testified on 6 May about a proposed SDI think tank before the Senate Subcommittee on Oversight of Government Management. When he was questioned about the propriety of setting up an SDI Institute, as the think tank would be named, with 5 of its 14 members coming from the SDI advisory committee that recommended its establishment, O'Neill claimed he was not familiar with the details of the proposal.

Subcommittee chairman Carl Levin, a Michigan Democrat, argued that the proposal is "a bit incestuous" in leaving that open the possibility that trustees of the SDI Institute—who include avowed "Star Wars" advocates such as retired Air Force General Bernard Schriever, former US Attorney General William French Smith and former National Academy of Sciences President Frederick Seitz—could also be appointed as its officials, at annual salaries ranging up to $225 000. In reply to some tough questioning by Levin and Senator John W. Warner, Republican from Virginia, O'Neill said he had not read what SDI proposed in the way of filling the institute's top jobs but he denied that the appointees would be ideologically hard put to oppose Star Wars policies or programs.

"The idea that there could be no dissent is—I hate to say it—ludicrous, but I wouldn't worry about that, sir," he told Levin. O'Neill also disavowed responsibility for a statement in an SDI report sent to Congress only a month earlier that indicated the institute's director and senior department heads would have to be acceptable to SDI. As he continued his marathon explanation, however, O'Neill admitted that it was possible that the think tank executives would be subject to veto by SDI officials. Levin scowled.

—Irwin Goodwin □