PLANETARY SCIENCE

Clementine 2 to Size Up an Asteroid

If all goes according to plan, the world will get its first close-up look at a potential planetary assassin in 1998, when a nimble, low-cost spacecraft will rendezvous with three asteroids whose paths cross Earth's orbit.

Nestled unobtrusively in the $243 billion defense budget for 1996, which became law last week, is the first $20 million installment for a follow-on mission to last year's Clementine 1, a $100 million probe that used cheap, sophisticated sensors to map the moon. Clementine 2 scientists from the Lawrence Livermore National Laboratory (LLNL) and the Naval Research Laboratory (NRL) plan to apply the same penny-pinching strategy to deliver "our first close-up look ever at an Earth-crossing asteroid," says Eugene Shoemaker of the U.S. Geological Survey in Flagstaff, Arizona, the project's chief science adviser. "I think we're going to have a very exciting mission."

The Pentagon's Ballistic Missile Defense Office (BMDO) sponsored the first Clementine, viewing it as a test bed for sensor technology. Since then, BMDO has dropped out, but the Air Force Space Command has snapped up the program. Shoemaker, a co-discoverer of the comet that slammed into Jupiter last year, says the Air Force has adopted "planetary defense" as a new mission area, "and Clementine is definitely part of it."

The spacecraft will cost between $100 million and $120 million, a fraction of the cost of a traditional NASA mission. NRL scientists have already begun searching for asteroids that will cross Earth's orbit in late 1998, the target launch period, hoping to find three that can be visited in a single mission. LLNL scientists will design low-cost, light-weight sensors and cameras that will map the asteroids from a distance of a few hundred kilometers.

The spacecraft will also be armed with three probes, one per target asteroid. These impactors will photograph the asteroids at close range; then they will slam into their targets. The mother ship will scrutinize the resulting dust and fragments for clues to the asteroids' composition and structure.

To keep launch costs down, all that technology will have to fit in a package weighing just 180 kilograms, 40 kilograms less than the first Clementine probe. That leaves just 10 kilograms for each camera-equipped probe. "It's tough, but it's doable," says Ed English, a project scientist at LLNL.

To scientists who advocate developing a defense against asteroids that threaten to collide with Earth, notably LLNL's Edward Teller, it's only a first step. Clementine 2 "is the only realistic way we can get information on the mechanical properties of these objects," says Shoemaker. The next step, say Shoemaker, Teller, and others, is to figure out how to destroy them.

–Jonathan Weisman

Jonathan Weisman is a science and defense writer at The Oakland Tribune.

JAPAN R&D BUDGET

Public Spending Falls for First Time

TOKYO—Government R&D spending in Japan declined last year for the first time in 40 years, according to new figures released last week. The drop comes at the same time corporate spending on research—which makes up almost 80% of the country's total R&D investment—declined for the third year in a row.

Officials say the main reason for the 1.6% drop in government spending, to $29.2 billion, was a large economic stimulus package that boosted research by almost 10% in 1993. The upward trend is expected to resume in 1995 because another large supplemental spending bill approved this fall will add billions of dollars to ongoing research programs. But scientists and policy-makers say that a steady and predictable increase in base budgets would be better for research planners than a sudden windfall from an economic stimulus package. Scheduled increases would also be more in tune with a campaign to double government R&D spending by 2000.

The latest figures on Japan's research expenditures come from an annual survey, including more than 10,000 private corporations, 1500 research institutes, and 2500 universities, conducted by the Management and Coordination Agency. The drop in government spending on research during fiscal year 1994, which ended 31 March 1995, was the first recorded dip in the history of the survey, which began in 1953. Private spending dropped to $106.6 billion, a 1% decline from 1993 and a 5.2% drop from a peak of $112.6 billion in fiscal year 1991.

Shin Aoyama, director of the research division of the Science and Technology Agency's (STA's) policy bureau, says that the 1993 supplemental spending packages added $5.5 billion to base research budgets. In contrast, new spending packages for 1994 boosted research by only $100 million, and the drop in supplemental spending outweighed a small increase in base budgets.

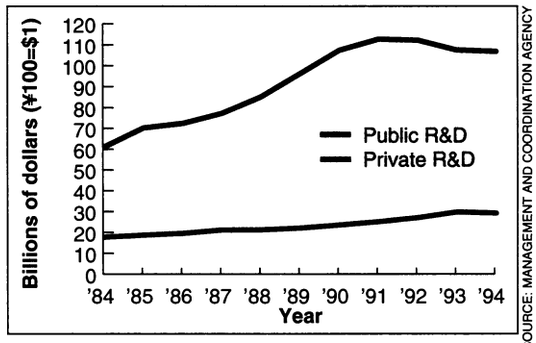
This two-steps-forward, one-step-back pattern is likely to be repeated in 1995–96. With the nation's economy still in the dumps, the government this year enacted two more supplemental spending packages, including an additional $6.8 billion for research-related equipment and infrastructure. But Aoyama says it is unlikely that such mammoth supplemental spending packages will be approved year after year.

Although scientists welcome the shots in the arm from the supplemental spending bills, they would prefer to see a larger rise in base budgets. "For continuity, we'd rather see that level of spending in the original budget, instead of the supplemental budgets," says Masao Ito, a neurobiologist at the Institute of Physical and Chemical Research outside Tokyo and president of the influential Science Council of Japan. Ito is also a member of the Council for Science and Technology, an advisory body to the prime minister, which in 1992 recommended that the government double its spending on research. The cabinet adopted the policy later that year but declined to set a target date, specifying only that it be "as soon as possible."

Ito says support for the doubling to occur by 2000 is growing within government research agencies. Earlier this year the STA, the Ministry of International Trade and Industry, and the Ministry of Education, Science, Sports, and Culture began including the date in position papers, although it is not official government policy. The biggest holdout is the Ministry of Finance, which is trying to reverse a growing budget deficit exacerbated by the continuing recession.

Within the commercial sector, Japanese companies are continuing to expand R&D activities overseas even as they rein in domestic spending. The management agency's report notes that expenditures outside of Japan, mostly in applied research, hit an all-time high of $140 million.

–Dennis Normile



In step. Both government and corporate R&D spending in Japan dropped last year, continuing an industry trend.