Operation Spacewatch

A group of astronomers is preparing to scan the skies for asteroids

With luck, and some creative financing, a small telescope on Kitt Peak in Arizona could next year begin Spacewatch, the first comprehensive, automated search for asteroids that pass near the earth.

The project has received surprisingly wide support, says University of Arizona astronomer Tom Gehrels, co-principal investigator of the project. First, and perhaps most important in the near term, Spacewatch offers a chance to study the origin and evolution of the solar system. Gehrels, for example, wants to study the asteroids' composition. Some of these objects are thought to contain very primitive material relatively undisturbed since the formation of the planets.

There is also the recent speculation that an asteroid impact killed off the dinosaurs and many other forms of life at the end of the Cretaceous period. Some people are afraid of asteroids, says Gehrels. The vast majority of these objects orbit in a belt between Mars and Jupiter, but the preliminary surveys done to date have turned up about 50 1-kilometer-sized objects whose highly eccentric paths loop across the orbit of the earth.

Eugene Shoemaker of the California Institute of Technology, the other senior investigator on Spacewatch, estimates that a comprehensive survey will turn up about 1000. Sooner or later one of them will hit the earth. In 1980, the NASA Advisory Council endorsed the Spacewatch concept on this very ground, suggesting that with enough warning an asteroid could be deflected with missiles.

There is another kind of paranoia at work, too, says Gehrels. A 1-kilometer asteroid would hit with an energy of about 25,000 megatons. Even a much smaller object could devastate a large city. The Department of Defense is interested in early warning lest somebody mistake such an impact for a nuclear attack and start launching missiles.

NASA likes the idea of Spacewatch from the point of view of mission planning. For example, the earth-crossing asteroid Anteros is well placed for an unmanned spacecraft to visit it and perhaps return a sample to earth. Spacewatch may turn up some even better candidates.

Then there are the visionaries who want to mine the asteroids. In their view, Spacewatch is a prospecting effort: meteorites, some of which are thought to be fragments of asteroids, indicate that certain metallic asteroids might be as much as 50 percent nickel and iron, with substantial admixtures of the platinum group metals. The platinum group metals alone might make an asteroid mining expedition economic in the near future.

The traditional method of finding asteroids has been to take time exposure photographs of the sky through a wide-field Schmidt telescope. Stars will show up as points, a moving asteroid as a streak. But this approach has severe limitations, says Gehrels. Not only is it difficult to get telescope time for such purposes, but the film misses the fainter objects. Besides, a fast-moving nearby asteroid may be out of sight in a week. By the time the plates are developed and scanned by a patient pair of human eyes, there may be little time left to study it.

The solution proposed by Gehrels and Shoemaker is the Spacewatch Camera, a 1.8-meter telescope dedicated to the search. In operation, the system would automatically scan a strip of sky for 5 minutes, focusing the starlight onto a charged coupled device (CCD), a very sensitive solid-state detector. The image on the CCD is then transferred in digital form to a computer and the scan is repeated. Comparing the two images, the computer looks for little points of light that have moved—asteroids.

Spacewatch has been in the works for several years now, says Gehrels. NASA, always enthusiastic about the project, has given the team a high-input computer and has funded development of the software to automate the scans. The group has several CCD's of suitable quality. The University of Arizona has made a dome available on Kitt Peak; the 0.9-meter instrument now in the dome will be used for preliminary tests of the system. Designs for the 1.8-meter telescope are ready.

With the recent round of budget cuts, however, NASA may have to withdraw virtually all its funding for Spacewatch. So Gehrels, determined to keep the project alive, has turned to the private sector. "We're talking with the Planetary Society in Pasadena, the Space Studies Institute in Princeton and the Space Foundation in Houston," he says. "The National Geographic Society has encouraged us to submit a proposal. A Japanese foundation may come in." He has even run an advertisement in the *Wall Street Journal*. He believes he can get sufficient funds in this way to operate the Spacewatch camera; what he needs now is about $1 million to build it.

Gehrels feels a certain personal urgency about finding that money. He is helping scientists in India build their own Spacewatch camera. "It was always understood that we would lead the way and provide the CCD's and software," he says. Now it looks as if they could finish first. They might even build an extra telescope and send it to the United States. "It would be horribly embarrassing," says Gehrels.

—M. MITCHELL WALDROP

Asteroids in Rings

For more than a decade, astronomers have been using spectrophotometry to classify asteroids according to composition. The largest asteroid, 1000-kilometer-diameter Ceres, for example, resembles a carbonaceous chondritic meteorite. Juno looks like a stoney-iron meteorite; 16 Psyche, like a metallic meteorite. Surprisingly, a recent survey of some 500 asteroids in the main belt between Mars and Jupiter has shown that the different types tend to sort themselves into concentric bands (albeit with considerable overlap). The work was done by Benjamin H. Zellner and David Tholen of the University of Arizona, Edward F. Tedesco of the Jet Propulsion Laboratory, and Jonathan C. Gradie of Cornell University. They can offer no explanation of the phenomenon, but they do note that the darker types tend to lie farther out. The outermost, in fact, appear to be covered with a tar-like material found in certain very primitive meteorites. So does the baffling dark hemisphere of Saturn's moon Iapetus, they find, which rules out the theory that Iapetus has been coated with dust from Phoebe, the next moon outward. Phoebe has the very different spectrum of a carbonaceous chondrite.—M.M.W.

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