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LONG DAY'S JOURNEY

STARS

By Marcia Bartusiak

The year is 2010. A dumbbell-shaped, unmanned space probe called *TAU* slowly spirals outward from a low Earth orbit. The only evidence of *TAU*'s gentle forward motion is the faint blue glow of its ion engines, where energized gas is being expelled at 60 miles per second. Its power source, a million-watt nuclear reactor, sits at one end of the 400-foot-long spacecraft.

After ten years, now well beyond the edge of our solar system, *TAU* will have used up the last of its 40-ton supply of propellant. Its propulsion system will be jettisoned, and its scientific payload—a 60-inch telescope and measuring instruments—will split into two free-flying sections. The twin craft will continue to hurtle outward, having reached a maximum speed of nearly 250,000 miles per hour. As they race through the vacuum of space, the twin units will be beaming pictures of stars and data on everything from gravity waves to magnetic fields. Because sending the data—some 20,000 bits per second—back to Earth by radio consumes too much power, *TAU* will transmit them over a laser beam.

TAU's mission—to measure our galaxy—will take 50 years. By the half-century mark its odometer will register a thousand astronomical units (A.U.'s), hence the name *TAU* (one A.U. being the 93-million-mile span between Earth and the sun). The two-part probe will have covered some 100 billion miles and be 25 times farther out than Pluto. By then a *TAU* transmission will take a week to reach us, and our sun will appear as little more than a bright dot in a black sky.

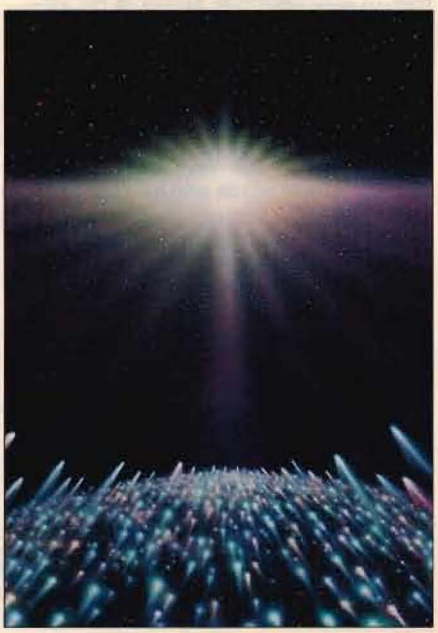
This mission, if funded, will be the deepest, fastest plunge humankind has ever made into interstellar space and will provide a mother lode of astronomical data for generations of astronomers.

The idea of sending a spacecraft billions of miles beyond the planets has been around for years; but it didn't receive serious attention until 1984, when Lew Allen, director of NASA's Jet Propulsion Laboratory (JPL) in California, decided to revise the concept of such a craft. To organize a research team and study the project, he chose the husband-and-wife team of Aden and Marjorie Meinel, both space scientists at JPL.

The Meinels decided that one of *TAU*'s missions would be astrometry, the unglamorous art and science of plotting the distances of celestial objects.

Currently, astronomers can measure precise distances only to stars close to the sun. To do this they use a triangulation method: They plot the position of a star from one point in Earth's orbit and, six months later, from another point. From this, astronomers can determine how a star's position shifts against the celestial background. This shift, or parallax, can be spotted for objects as far away as 500 light-years. For stars and nebulae farther out, they have to use a complex chain of theoretical assumptions.

TAU would extend astronomy's yardstick beyond the 500-light-year limit. Out in space *TAU*'s telescope, the centerpiece of its payload, could take aim at a star while a similar instrument orbiting the earth did the same. From these two vantage points, parallax measurements could be done, even into the next galaxy, 2 million light-years away.



The TAU *mission. Tripping the light fantastic.*

Astrometry will be only part of its mission. "Science will be done from the moment *TAU* is launched," says Aden Meinel. Already the proposed mission calls for more than a dozen experiments, including a search for gravity waves and the first sampling of gases and magnetic fields in undisturbed interstellar space.

Near the end of its life span *TAU* would approach the inner edge of a distant realm of space called the Oort Cloud—conceived by Dutch astronomer Jan Oort—where innumerable chunks of rock and ice, remnants from the birth of our solar system, are supposedly clustered. It is believed that every now and then a gravitational nudge from a passing star knocks loose odd pieces and sends them tumbling toward the sun. As they pass by, we see these as blazing comets.

TAU's telescope would be able to study the silhouettes of Oort fragments in place as they moved in front of bright star fields. These shadows would let astronomers see the size, mass, and amount of material in that cosmic refrigerator.

Could a spacecraft built using existing technology possibly operate for 50 years? Aden Meinel is optimistic, even though scientists have to clear several engineering hurdles. *TAU*'s ion engines, now being designed at JPL, will have to increase their power a hundredfold; laser communications equipment will have to be built and tested; existing long-duration nuclear reactors will have to be improved. Meinel thinks there is time to develop all of this before the anticipated launch date sometime between 2010 and 2020.

Finally, the Meinels, both in their mid-sixties, are often asked if they have any qualms about working on a project that would arrive at its planned destination long after they are gone. Marjorie Meinel points out that for her, *TAU* is the continuation of a family tradition; 70 years ago, in 1917, her mother was making astrometric measurements at the Yerkes Observatory in Wisconsin. For his part, Aden Meinel says that he and his wife would be quite happy "just to wave good-bye."