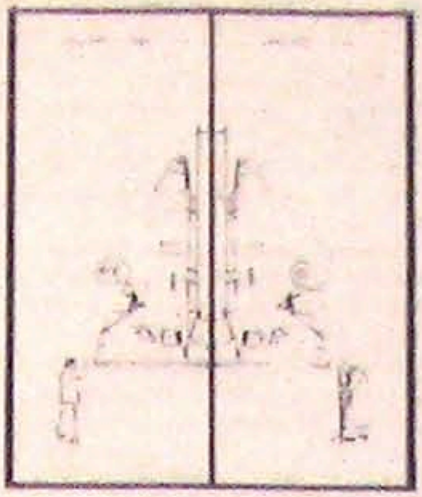
STARBOUND

by Dr. Eugene F. Mallove



The Twin Paradox

Is it possible to be a time-traveler to the distant future without aging appreciably? Surprisingly, the answer is yes, and the consequences of Einstein's relativity theory support this. The best illustration of this feasible form of time-travel is the so-called "twin paradox" or "clock paradox."

Two twins say good-bye to each other as one boards a rocketship bound for an extremely high-speed journey. The rocket accelerates to near light speed (186,000 miles per second) and coasts for a while. Then the rocket decelerates, turns around, and accelerates to near light speed again for the return trip to Earth. When the rocket nears Earth after its long coasting phase at high speed, it decelerates and then lands. Depending on how far and how fast the rocket-born twin travels, he returns home to find his twin either much older than himself, his twin long since dead, or an unrecognizable Earth thousands, if not millions, of years advanced from the time the rocket departed.

An observer on Earth might record that the rocket had been gone for millions of years, yet only a fraction of a normal human lifetime might have elapsed on the rocket! While it is not practical today to build rockets which attain a speed of anywhere near 99% of light speed, few physicists doubt the real possibility, in principle, of twin "paradox." Numerous experiments in subatomic physics confirm that as an object travels faster, time slows down in the object's frame of reference as noted by a "stationary" observer. The *paradox* arises in the case of the twin's because the Theory of Special Relativity states that each twin should observe the other's time to be slowing down. They both cannot be older than each other upon return!

The resolution of the paradox is that the accelerating twin in the rocketship is very special by having decelerated and accelerated to turn around and come back. This confers a uniqueness on the traveling twin which allows him to be much younger than the stay-at-home when he returns. Providing that the rocket can get arbitrarily close to light-speed, it is possible for an astronaut to visit any point in the visible universe and return to Earth in the span of a normal human lifetime! This is true even though the journey would appear to be billions of years long to the Earthbound observer. This is one-way-only time-travel—the past could not be visited.

Dr. Mallove encourages readers to send in questions and will occasionally devote a column to them. He lectures on topics involving astronomy and the space program to groups and organizations. He can be reached at 429-3737.