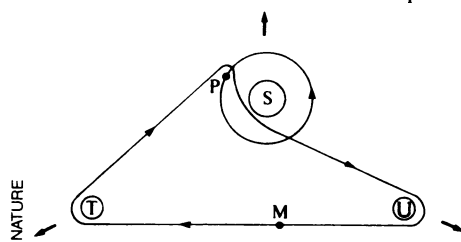


## The great escape

Mathematicians have long been attracted to the theoretical problem of how planets and other bodies gravitationally push and pull each other around. In particular, they wonder about the special cases, called singularities, that occur when two or more bodies collide or when all of the bodies escape beyond reach. Finding these special cases is difficult because the differential equations that describe the motions of more than two bodies are impossible to solve exactly. Astronomers and others who track planetary motion or compute the paths of satellites and space probes rely on techniques that provide approximate, but for their purposes sufficiently accurate, answers. Now, Joseph L. Gerver of Rutgers University in Camden, N.J., presents a plausible argument for the existence of at least one arrangement of five bodies that, under the influence of gravity, fling themselves out to infinity in a finite time. This singularity is the first to be found that doesn't involve collisions and requires as few as five bodies.



Gerver's scheme, as outlined in the March 30 *JOURNAL OF DIFFERENTIAL EQUATIONS*, begins with a triangle of three points (or "stars"), each point having a large mass but occupying no space (see diagram). A "planet" circles one of the stars. The stars have initial speeds so that the whole triangle slowly expands while maintaining its shape. The fifth body, a "meteorite," rapidly whips around the triangle, coming close to each of the other four bodies in turn. If its timing is just right, on each pass the meteorite picks up a small amount of energy from the planet, which loses kinetic energy and falls to a lower orbit. The same "slingshot" effect was used to propel the Voyager spacecraft toward Saturn and beyond. As it orbits, the meteorite transfers a small fraction of the energy that it has just gained to each of the stars, causing the triangle to expand at a faster rate. Meanwhile, the time for each meteorite trip decreases so that within a finite time the whole triangle becomes infinitely large.

Although his argument, according to some mathematicians, is convincing, Gerver's paper does not prove that this solution actually exists. "I have attempted such a formal proof by brute force with partial success and feel that this proof could probably be completed," says Gerver, "but [it] would require hundreds of pages of calculations."

Gerver's delicate balancing act has no analog in the "real" universe, where stars and planets are more than just dimensionless points in space and where the special theory of relativity sets a limit on how fast bodies can move. Nevertheless, says Ian Stewart of the University of Warwick in England, commenting in the Nov. 29 *NATURE*, "Gerver's idea is a bold, imaginative thrust at the heart of a celebrated problem, and a challenge to the current mathematical techniques. Isaac Newton would have loved it."

## Digital pieces of pi

Although pi, the ratio of a circle's circumference to its diameter, can be expressed precisely only by an infinitely long string of decimal digits, most people are satisfied with knowing that pi is approximately 3.14 or 22/7. That isn't enough, however, for some researchers who want to know whether the sequence of digits representing pi is truly random. Last year, as noted in *THE MATHEMATICAL INTELLIGENCER* (Vol. 6, No. 3), Japanese computer scientists managed to compute the number to 16,777,216 decimal places. They confirmed that their computation was correct for at least the first 10,013,395 digits, the present world record. They are now planning the computation of pi to 33,554,432 places.

## 'Asylums' for the homeless

Even on a frigid winter's night, shelters for the homeless are more than a warm refuge for people with no money and nowhere to go. According to Harvard Medical School researchers, these shelters have become "open asylums" taking the place of more traditional mental hospitals and clinics. In a representative shelter in Boston, the vast majority of homeless people have severe psychiatric disorders, the researchers report in the December *AMERICAN JOURNAL OF PSYCHIATRY*.

"Despite limitations in current research, it is becoming increasingly clear that many homeless people are severely mentally ill and in need of mental health services," say Ellen L. Bassuk and colleagues. On Feb. 25, 1983, they gathered background data on more than 1,000 people in 27 Boston-area shelters. Two months later, they returned to a shelter where the homeless guests closely matched the overall sample. All 78 people staying at the shelter were interviewed. Nine out of 10 people were given psychiatric diagnoses: About 40 percent had psychoses, including schizophrenia and manic depression, 29 percent were chronic alcoholics and 21 percent had personality disorders. The healthy exceptions were children of adults in the shelter and a few men who had just arrived in Boston looking for work.

Only about a third of the shelter guests had been hospitalized for psychiatric care. This indicates, say the investigators, that the movement over the past two decades to release people from mental hospitals has not played a major role in swelling the ranks of mentally disturbed street people. However, the most common age in the current homeless population is 34 years, they add; many of these people became psychotic after long-term hospitalization lost favor.

Bassuk and co-workers conclude that the "hallmark" of the homeless mentally ill is a virtually total loss of connections to family, friends and social service agencies. Three-quarters of the overall sample said they had no family relationships or friends to provide support; 40 percent said they had no relationship with anyone, not even at a shelter.

## Deciphering dopamine's decline

Receptors in the brain that serve as conduits for the chemical messenger dopamine, which has been implicated in Parkinson's disease and schizophrenia, may decline sharply with age — possibly to a much greater extent in men than in women, according to a preliminary study at Johns Hopkins Hospital in Baltimore.

Dean F. Wong and colleagues used a positron emission tomography (PET) scanner to examine receptor binding in healthy volunteers. The device measures radioactivity emitted by an injected chemical that binds to dopamine receptor sites; a receptor "map" is then generated on its computer screen.

In a study of 22 male and 22 female subjects ranging in age from 19 to 73, the Hopkins scientists found that dopamine receptor binding fell by 46 percent across the age span for men and by 26 percent for women. "A likely explanation for the decline in binding with age is that the number of receptors decreases," they report in the Dec. 21 *SCIENCE*.

Wong and co-workers also picked up a smaller decline in receptor binding with age for the neurotransmitter serotonin. There was, however, no difference between male and female serotonin levels.

The greater drop in dopamine receptor binding among men appears to be a normal consequence of aging, say the researchers. But they caution that more PET scan examinations are needed to confirm the data.

Natural declines in dopamine receptors may help scientists to understand disorders such as schizophrenia in which the dopamine receptor system appears to have gone awry, adds Wong.