1905. In an SST era, will today's long-haul 747's seem similarly quaint?

It depends, according to Boeing's John Swihart, on progress in the same three areas as for subsonic airliners: engines, materials, and aerodynamics. He thinks the right engine would be one that can switch between two different modes. At subsonic speeds, it would resemble an efficient fanjet. At supersonic speeds, however, the fan would get in the way, producing drag. So the engine must lead the airflow around the fan. The Air Force is devising somewhat similar engines for its Advanced Tactical Fighter, which will provide engine builders with some useful experience.

An SST will require composite materials that can withstand much higher temperatures than those to be used in subsonic planes. That means new, temperature-resistant epoxies that are still in the research laboratories. Drag reduction, too, gets more complicated at Mach 3. If it all comes together, Swihart projects, the result could be an SST offering 60 to 70 seat-miles per gallon. This would be a big step above the Concorde's 13 seat-miles per gallon and put an SST very much in the range of today's widebody planes. But the real question is whether an SST would be economically competitive not with today's subsonic planes, but with tomorrow's. That won't depend just on technical advances, but on how large the market for trans-Pacific travel grows and on how much of a premium people are willing to pay to reduce a 14-hour flight to four.

Getting to the Source

When you want to get the complete story and understand its full impact, there's no substitute for talking directly with the principal scientists. But it's not always easy.

For our story on brain implants, the key figure was Dr. Rene Drucker-Colin of the National University of Mexico. But since he and his colleagues announced successful treatment of two Parkinson's patients with this technique, his office has been flooded with phone calls.

Nevertheless, our reporter Ed Kiester got through and conducted a lengthy interview, turning up important new details of the Mexican team's current experiments. Likewise, reporter Marcia Bartusiak spent days on the phone and at scientific meetings, sorting out both the accumulating observational reports and the theorists' most recent calculations for our story on the Magellanic supernova. In both instances, the effort paid off.

Allen Hammond

P.S. We have a bonus for you in this issue, a two-page insert with a special report on the 3rd Generation PC's.

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Astrophysics

Cracks in Space-Time: A Cosmic String?

HONOLULU—Two astronomers at the University of Hawaii are reporting, very cautiously, that they may have found evidence linking several of the forces of nature together. Lennox Cowie and Esther Hu have found four closely-grouped pairs of twin galaxies that may not be twin galaxies at all. Instead the astronomers believe the pairs may be an optical illusion created by a cosmic string.

This bizarre phenomenon, postulated by theorists, is a crack in space-time caused by the rapid cooling of the universe in its earliest moments. Cosmic strings are thinner than an atomic particle but form large, astronomic structures or loops hundreds of light-years across. (They are totally unrelated to the microscopic superstrings proposed as fundamental objects in current particle physics theory, despite the confusing similarity in names.) Within such strings, the energetic conditions of the primeval fireball—the Big Bang—continue to prevail. And that energy is so concentrated that a few dozen yards of a cosmic string, would have as much mass as the Moon.

Not since black holes have such objects captured the imaginations of astrophysicists. They are in fact a by-product of the attempt by physicists to unify the forces of nature. They have built model after theoretical model, seeking to show that three of the forces—the strong and weak nuclear forces and the electromagnetic force—were once the same in the fiery kiln of the early universe. These grand unified theories envisage cosmic strings being formed within the first fractions of a second as the universe cooled from the Big Bang, the primordial explosion that gave birth to the cosmos some 15 billion years ago.

To see how cosmic strings may have come about, think of the birth of the universe as a kind of crystallization process, like water freezing into ice. As the embryonic universe expanded and cooled, the theories suggest, slender strands of highly concentrated energy could have endured—weaving a network of cracks in the topology of space-time. Recall the cracks or flaws in the surface of a frozen pond. But because cosmic strings—if they truly exist—are energetic and massive, their gravitational fields would be monstrously strong and should deflect light from stars in ways that can be detected by telescopes.

And that is just what Cowie and Hu think they may have found. As with so many astronomical findings, the discovery was serendipitous. Searching for distant quasars with a telescope atop Hawaii's Mauna Kea in the fall of 1985, the astronomers noticed something very peculiar: four sets of twin galaxies nestled close together (see photo). "At first, we thought we had accidentally taken a double exposure," recalls Cowie. They were puzzled because the probability of such a close-knit family of binary galaxies is extremely low.

Further observations a year later established that three of the pairs are 4.5 billion light-years from Earth; the fourth pair resides at a distance of 2.5 billion light-years.

This unusual grouping is best explained, the astronomers suggest, by a cosmic string looping through space somewhere between the galaxies and Earth, splitting each galaxy's image in two. It's as if the light from the

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galaxies comes upon an obstruction in space-time and gets diverted to either side, an effect known as gravitational lensing. Indeed, the two members in each pair are virtually identical; when galaxies do come in pairs, they are rarely so similar.

Based on the geometry of this possible space mirage, the string loop should be about 100,000 light-years across (the size of our Milky Way galaxy) and reside about one billion light-years away.

Announcing the discovery of a cosmic string, though, is fraught with peril. A similar announcement by a group of Princeton University astronomers in 1986 was quickly shot down, to their chagrin. Cowie himself has many reservations about this new candidate. "It could still be the accidental alignment of some binary galaxies," he cautions. "We need to take some deeper images of this sector to see if fainter galaxies are also being imaged twice. If so, I'd be more confident a string is at work." Those observations will be made in the fall.

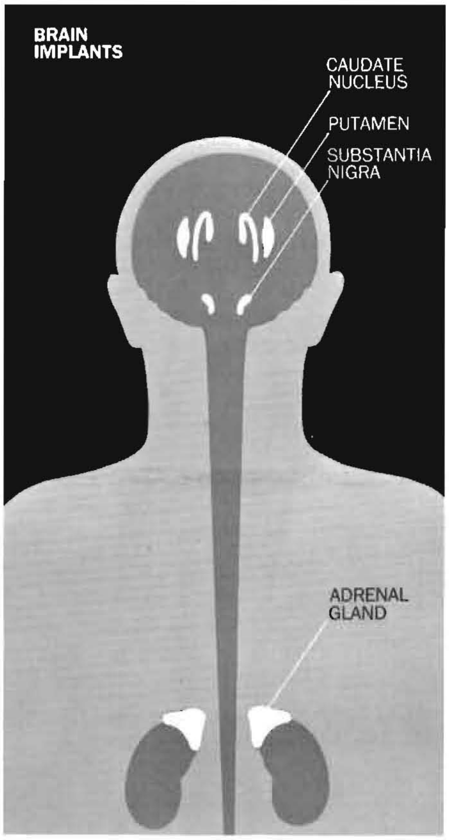
Though cautious, Cowie is well aware of the significance of finding a string in the universe. "It would be of monumental importance," he states, "the first concrete evidence for grand unified theories." The most complex imaginings of physicists to date, once thought impossible to test, would at last have experimental verification, rewriting the story of our cosmic evolution.

Brain Implants

A Cure for Parkinson's and Other Degenerative Diseases?

Brain implants are here. Once unimaginable, surgical invasion of the brain to graft new tissue seems likely to become a nearly routine medical procedure. Brain tissue does not readily heal itself. So brain grafts may alleviate symptoms caused by diseased or damaged tissue and thus offer an otherwise impossible "cure" for a wide variety of brain diseases. But this bright hope may also raise ethical and religious concerns.

The hope was born of a Mexican neurosurgical team that recently reported dramatic and, so far, lasting improvement in two patients with Parkinson's disease. The improvement followed an operation in which tissue from their adrenal glands was implanted into their brains. Almost immediately after the Mexican team had published their results, doctors at several U.S. hospitals began brain implant operations as well. By mid-May, little more than a month after the initial report, surgeons here and in Mexico had already operated on two dozen patients. By this fall, one federal official predicts, "a number of first-class institutions will be doing brain implants regularly."



Parkinson's disease results from the deterioration of the substantia nigra deep within the brain. That starves the brain of the chemical dopamine, without which nerve cells in the caudate nucleus and putamen cannot coordinate body movements properly. Dopamine-producing cells from the adrenal gland, transplanted into the brain and attached to the surface of the caudate nucleus, seem to reverse the symptoms.

That is potentially good news for those who suffer from Parkinson's disease—nearly half a million in the United States alone—and perhaps for victims of other degenerative brain diseases as well.

A decade ago, successfully transplanting tissue inside the human brain was considered impossible. But the pioneering animal experiments of Swedish tissue specialists Lars Olson and Ake Seiger led in 1982 to the first attempts with human patients. The operations were performed in the prestigious Karolinska Institute, Stockholm, by neurosurgeon Erik-Olof Backlund. Two others were conducted in 1985. All four Swedish patients improved after the surgery, but the improvement was slight and gradually ebbed over the next few months. Thus, when the Mexican team headed by Rene Drucker-Colin of the National University of Mexico published a report of glowing results, the news electrified neuroscience.

A Rush To Implant

One week to the day later, the first U.S. operaton was performed at Vanderbilt University Medical Center. Even so, Vanderbilt barely beat out an operation at New York University. Several other hospitals in the United States and China either have begun implant surgery or are about to do so.

The Swedish and Mexican operations differed technically, but the principle was the same. Parkinson's disease strikes when two clumps of specialized brain cells, the substantia nigra, die or decline. These cells produce the chemical dopamine, vital for initiating such actions as walking and speaking. As the dopamine supply dwindles, the victim becomes rigid and tremulous, loses mobility, and may eventually become bedridden. The medication L-dopa—a chemical that is a biological precursor of dopamine—relieves symptoms in most patients but gradually loses its punch.

However, dopamine is also produced elsewhere in the body, in the adrenal glands above the kidneys. Both the Mexican and Swedish operations remove these cells from one of the person's own glands and transplant them into the brain.

In Sweden, doctors injected the adrenal cells deep on both sides of the brain near the substantia nigra. The Mexican group chose a different location: They placed the implant in a brain cavity or ventricle, attaching the adrenal cells with metal clips to the surface of the caudate nucleus—specialized brain cells that use dopamine. The clips keep the implanted cells in place. The Mexicans chose this particular location for the implant so the graft would be bathed and nourished by the cerebrospinal fluid that flows through the ventricle. Contact with the fluid appears essential to the graft's survival, according to Mexico's Drucker-Colin. Other scientists, such as transplant pioneer William J. Freed of the National Institute of Mental Health (NIMH), agree.

Amazing Results

The Mexican scientists have already performed 15 transplants and are planning at least five more. And so far the results amaze them. "I can't believe it myself," Drucker-Colin told *Science Impact* in a recent interview. He describes one case, 39-year-old Patient No. 12: "This man had a tremendous tremor. His entire body shook. He had such great rigidity that he could walk only a few steps at a time, and could barely write his name. He held the pencil between thumb and forefinger and supported the hand with the small finger, like drawing with a compass. Two weeks after the operation, he could write and draw circles, and could not only lift his feet, but do sit-ups."

continued on page 5.