New Clues to the Fifth Force and Its Source

Physicists have recognized four kinds of force in nature. Two of these, gravity and electromagnetism, have a potentially limitless range. The other two, the "strong interaction" and the "weak interaction," are hardly perceptible beyond the diameter of an atomic nucleus.

Now there is growing evidence for a fifth force, which would be of middle range, between 10 meters and a kilometer. The latest experiment, done in the Cascade Mountains of Washington and said to be more sensitive than previous ones, shows a positive effect that may actually be this fifth force.

The idea of a fifth force arose from measurements done in mines in Australia a few years ago, in which gravity seemed weaker than it should be. The best explanation seemed to be that another force was acting — a medium-range force that was repulsive but much weaker than ordinary gravity, and that depended on the nature of the substance involved, as ordinary gravity does not. Some experiments since have shown some such effect; others have not (SN: 8/29/87, p.135).

If substantiated, the fifth force would bring about a serious change in accepted physics, and so even the physicists whose experiments show an effect are being cautious in the claims they make. In the Sept. 28 PHYSICAL REVIEW LETTERS, the authors of the latest report, Paul E. Boynton and Anthony Szumilo of the University of Washington at Seattle and David Crosby and Phillip Ekstrom of Northwest Marine Technology in Shaw Island, Wash., say of their positive signal: "It may be easier to demonstrate what the signal is not than to discover its true cause."

Nevertheless, as Boynton told SCIENCE NEWS, "We see an effect consistent with a fifth force that depends on composition." The report also shows how the previous experiments, both positive and negative, can be made consistent with each other and with this one on the assumption that the fifth force acts in a certain way.

Ordinary gravity is not supposed to take account of the chemical difference between substances; it depends merely on the amount of mass present. The way to determine whether a composition-dependent force is acting is to do the usual kind of gravity experiment, measuring the attraction of a large body (the whole earth or part of it) for a small test mass, but making the test mass of different substances. The Washington experimenters used a ring, made half of aluminum and half of beryllium. To equalize the amount of mass in the two halves, they drilled a series of holes in the aluminum side.

They then hung the ring from a wire in a torsion balance and proceeded to measure the attraction for it of a vertical cliff face. If the cliff attracted the aluminum differently from the beryllium, the ring should have twisted. Rather than measure simply the twist (which would have been extremely small), they set the ring oscillating and measured the difference in the oscillations as the ring's orientation with respect to the cliff was changed.

They found a difference, and, after considering the possibility of systematic errors in the experiment, they conclude, "The phase of the signal maximum . . . is appropriate . . . to a static interaction of the cliff mass with some kind of asymmetry between the [beryllium] and [aluminum] halves of the pendulum ring."

In other words, the cliff seems to pull differently on beryllium than it does on aluminum. The next question is what quality in beryllium and aluminum makes the difference. The answer to that impinges on the question that Boynton expresses as: "Our results and all others — are they consistent?"

Some scientists working on the fifth-force question have assumed that the source of the force is the baryon number of the substance — the total number of neutrons and protons in its atomic nuclei. The Washington group suggests, however, that if one supposes the relevant quality to be the isotopic spin — the number of neutrons *minus* the number of protons — all the experiments can be made consistent.

Isotopic spin distinguishes one isotope of an element from another. It is also important in the behavior and transmutations of subatomic particles. If it is the source of the fifth force — as mass is the source of gravity, or electric charge the source of electrical forces — then the experiments that showed no effect should not have seen one, given their sensitivity limits and the range of values they investigated, and the experiments that showed the positive results are also plausible.

The Washington group is already working on a follow-up that substitutes a ring made of copper and polyethylene. If the isotopic-spin hypothesis is correct, they say, the resulting signal should be three times that in the aluminum-beryllium version. — *D. E. Thomsen*

Cyclosporine, low cholesterol: Bad mix?

A drug commonly used to suppress the immune system and prevent organ rejection may cause serious nervous system toxicity in 25 percent of liver transplant patients, scientists said this week. The reversible neurological side effects of the immunosuppressant, called cyclosporine, apparently increase in frequency among those with lower blood levels of cholesterol.

Researchers at the Mayo Clinic and Foundation in Rochester, Minn., observed signs of severe neurological toxicity in three transplant patients being given cyclosporine, according to a report in the Oct. 1 NEW ENGLAND JOURNAL OF MEDICINE. They were aware that the drug's adverse effects on the kidney were well known, but the extent of its influence on the nervous system was unclear. By reviewing the records of 48 previous transplant patients, they found that 13 had neurological symptoms attributable to cyclosporine. Of particular interest was the fact that the affected patients had average cholesterol levels roughly two-thirds those of unaffected patients.

Cyclosporine "definitely has neurological toxicity," Mayo's Ruud A.F. Krom told SCIENCE NEWS. "It is far more common than officially recognized. But you have to distinguish it from depression and character changes [common after major surgery]." Symptoms, which vary with the individual patient, include confusion, disturbed sleep, blindness and seizures.

Krom says the observed toxicity is most likely related to the blood transport mechanisms that carry cyclosporine, which binds to lipids. "With low blood cholesterol, it is possible that the amount of free cyclosporine is elevated," he says. "The brain is very eager to pick lipid particles out of the blood to make myelin sheaths [around nerves]. So when cholesterol is low, the free cyclosporine can bind to receptors at the blood-brain barrier more easily and enter the brain." Krom suggests that the dip in cholesterol during the first two weeks after a liver transplant could be caused by factors like antibiotic therapy or rerouting lipid-binding bile outside the body.

Fortunately, says Krom, the neurological symptoms are completely reversible when cyclosporine treatment is discontinued or sufficiently decreased. "Dramatically, in just a couple days, you see a patient go from being on a respirator with seizures to completely normal," he says. — *D.D. Edwards*