he tested could block out pain with post-hypnotic suggestion. He believes others can be trained to do the same, with important implications for medicine. "It would be a great thing to have," he said.

Hypnosis has, in fact, been used to successfully anesthetize burned patients and women in childbirth. Clinics have a slightly higher rate of success than the 10 percent he found, said Dr. Hilgard, possibly because patient expectations are higher. His own subjects knew they were part of an experiment and may have thought they should feel the pain.

Dr. Hilgard had his subjects immerse their hands in a tub of ice water until they could no longer stand the cold. All had been previously tested for susceptibility to hypnosis and had been told they would not feel pain. Those who responded felt no more pain after 60 seconds than they had after the first five.

One girl was able to block pain on her own, by studying a spot on her skirt. She was, incidentally, not hypnotizable, but could redirect her attention and effectively prevent pain from reaching consciousness. Dr. Hilgard said that probably one in a hundred people are capable of this.

Just what the mental mechanism is for controlling pain remains a mystery, but Dr. Hilgard believes it is located in the higher neural centers concerned with attention and alterations in consciousness.

Helium Near Zero

The strange properties of liquid helium have fascinated and puzzled scientists and laymen alike for some 30 years. At temperatures near absolute zero, liquid helium becomes a superfluid—conducting heat with greater efficiency than metals, flowing up the sides of its container and seeping through holes smaller than the size of a helium atom.

Many, but not all, of the superfluid's properties are understood.

A way to explain one aspect of helium's behavior at temperatures below 2.17 degrees K. was reported to the American Physical Society meeting in Washington last week by Dr. Lyle B. Borst of the State University of New York in Buffalo. A cupful of liquid helium, he said, acts as if it consisted of a collection of constantly changing pairs of helium atoms. Their motion, can be described by the rules of quantum mechanics. As an analogy, he cited the following:

If Niagara Falls were helium, first, they would never freeze; helium freezes only under high pressure. The falls themselves would not be unusual, but strange things would happen at the Whirlpool below.

If the temperature dropped to just below 2.17 degrees absolute, the form of the whirlpool would not change. The liquid helium would form a vortex at the center. However, any person falling into the liquid would not be sucked under at the center, since the liquid would flow past him without effect.

Moreover, he would be unable to escape, because when he tried to swim his hands and feet would pass through the liquid equally without effect. This unusual behavior, called the Pellam paradox, shows clearly in photographs of an object inserted into the vortex of liquid helium in the laboratory—neither has any effect on the other. In ordinary liquids, the object would be caught and pulled down into the twisting vortex.

Dr. Borst believes the Pellam paradox and many other strange effects can be explained by considering liquid helium as a fluid whose atoms are paired in an endless exchange of partners. In a rotating liquid, the whirlpool of the analogy, a minuet takes place in which the atoms are always paired and always changing partners.

This condition can change only in jumps; an input of energy is required to produce any change at all. If the swimmer in the analogy were strong enough to change the whirlpool, he would immediately be caught by the moving liquid and sucked under.

At lower temperatures, within half a degree of absolute zero, Dr. Borst reports, the liquid can be described by a theory that requires no atomic structure at all. Helium, he says, then shows effects that are inconsistent with the presence of any atoms, a possible first exception to the atomic theory.

Nuclear Theory

A major theory about the structure of the atomic nucleus may have to be refined because of discrepancies in recent experiments. The discrepancies appeared in the observed and theoretical values of the magnetic forces in an isotope of antimony.

According to theory of the atomic nucleus—the so-called shell model—protons and neutrons are arranged in shells or rings. The number of shells depends on how many protons and neutrons it contains.

Various forces—electrical, magnetic, nuclear—act on the nuclear particles. The shell theory predicts how these forces act.

Recent experiments on magnetic forces in antimony, a metal used in many alloys, qualify the shell theory.

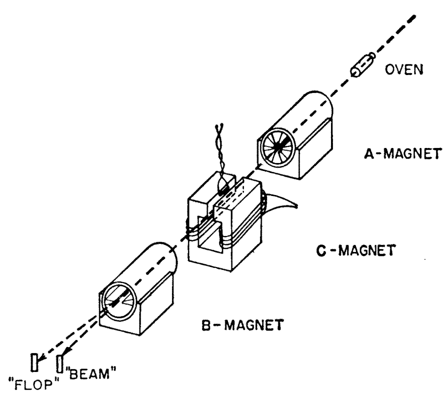
Reporting to the American Physical Society meeting in Washington, Geoffrey J. Garrett of the Palmer Physical Laboratories at Princeton University said values measured for three isotopes of antimony agreed with theoretical values. But for a fourth isotope, antimony 117, experimental values didn't match the theoretical.

Garrett said the reason for the discrepancy isn't understood yet. Either the theory will have to be revised or the experimental technique will have to be refined.

The four isotopes tested—antimony 117, 118, 119 and 120—were produced by bombarding tin with high-energy protons from the Princeton cyclotron.

The atoms were heated in an atomic oven to 1200 degrees C. At this temperature, they shot out of the oven through the fields of three test magnets.

The first magnet lined up the atoms so that all had a magnetic force pointed in the same direction. The second



Garrett

Magnetic test setup flips antimony.

magnet had a variable field, and the frequency of the variation could be adjusted. At the right frequency, the magnetic force of the atom would flip to the opposite direction.

The third magnet sent the flipped atoms to one detector, and the unflipped atoms to another.

From the shell theory, it is possible to compute what frequency the variable magnetic field should have to flip the atoms of each isotope of antimony that was measured.

In three isotopes, the experimental frequency matched the computed value. But in antimony 117, the experimental value was off by more than 25 percent.

The calculated values depend on the magnetic properties of the neutrons and protons that make up the nucleus. According to the shell model, the magnetic effects of the protons and neu-