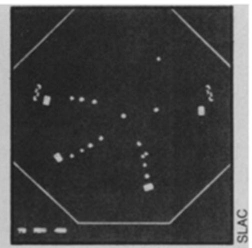
1976 Nobel Prizes: Clean Sweep for U.S.

Physics: Psi or J heavy particles

Brookhaven

SLAC



SLAC

Ting (left), Richter and the sign of the psi in SLAC*'s detector.*

Discovery of the first of a new class of subatomic particles, the so-called psi or J particles, has earned the 1976 Nobel Prize in Physics for Burton K. Richter of the Stanford Linear Accelerator Center in California and Samuel C. C. Ting of the Massachusetts Institute of Technology. Richter and Ting are leaders of two experimental groups that worked at opposite ends of the United States. Richter's group, made up of physicists from SLAC and the Lawrence Berkeley Laboratory, worked at SLAC's SPEAR storage ring; Ting's group, from MIT and Brookhaven National Laboratory, used Brookhaven's Alternating Gradient Synchrotron. In November 1974 (SN: 11/23/75, p. 324), both groups independently found a new, very heavy, oddly behaving particle.

The California physicists called the new particle psi from the shape of the paths made by the daughter particles that gave evidence of its existence. The designation applied in Long Island was J. Within a fortnight a similar, slightly heavier particle was found, and that began a procession of related discoveries that has continued the last two years and is not over yet. (For various experimental results, see SN: 1975 and 1976, *passim.*)

If the interpretation of the discovery chosen by the majority of theorists is correct, it opens entirely new chapters in both experimental and theoretical physics because the new particles are related to the workings of a newly hypothesized property called charm (SN: 1/25/75, p. 58). Charm was introduced to explain certain anomalies in the behavior of already known particles. Its introduction required fundamental revisions in the whole theory of subatomic particles (SN: 6/26/76, p. 408). The speed with which experimental evidence of its existence was found was highly gratifying to the theorists who believed in it.

The award of the Nobel Prize for the discovery also comes close to establishing a record for speed between the time of discovery and the time of the award, if it does not actually establish one. The more usual course has been to award the prize for work done long enough ago to have stood the test of time and acceptance. Apparently this means that in the opinion of the prize committee there is no longer the least doubt of the existence of the new particles or their importance to physics. The award also raises the question of big physics that had to come up sooner or later (and in fact surfaced in some grumbling over the 1974 award to Anthony Hewish). Dozens of physicists were involved in the experiments, but only the two leaders (who will share $160,000) were named by the committee. It may tend to increase the touchiness of negotiations over leadership positions in large experimental groups. □

Medicine: Slow viruses, Australian antigen

Photos: Wide World

Albertina Albert

Gajdusek (top), Blumberg, and a slow virus.

Medical research among primitive tribes in the Southwest Pacific has led to dramatic insights into the cause of certain neurological diseases and into the cause and prevention of hepatitis. It has also led to a Nobel Prize in Medicine for two American scientists who did the research—D. Carleton Gajdusek of the National Institutes of Health and Baruch S. Blumberg of the Institute for Cancer Research in Philadelphia.

During the 1950s, a medical patrol officer in Australia discovered that thousands of New Guineans suffered from a strange brain disease. They trembled, became rigid, fell down, swayed like drunkards, experienced seizures, passed into comas and died. The New Guineans called the disease "kuru," which means "fear of trembling." Gajdusek was in Australia at this time and heard about the disease. He went to New Guinea to try to determine the cause.

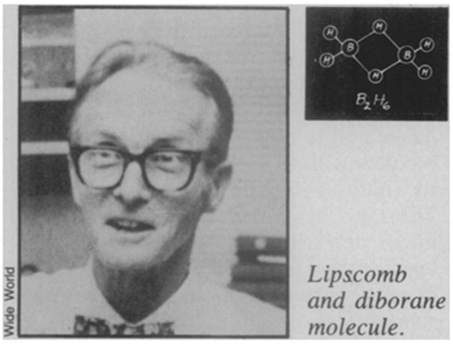
Talking with New Guineans, he learned that their tribal funeral customs included the eating and handling of the brains of deceased relatives as a mark of respect. He suspected that this custom might be responsible for passing kuru from one New Guinean to another, and that the disease was an infectious disease. During the 1960s, after joining the NIH, Gajdusek set out to prove that this was the case. With the help of another NIH colleague, Clarence Gibbs Jr., he succeeded in implanting filtered brain material from New Guinea kuru victims into the brains of chimpanzees. The chimps eventually came down with kuru, showing that the disease was indeed infectious. Since the filtered brain material could not contain an infectious agent larger than a virus and since it took this agent months or several years to trigger kuru, Gajdusek and Gibbs also arrived at the conclusion that kuru is caused by a slow-acting virus. This was the first evidence for a slow virus disease in humans, although several slow virus diseases in animals had already been identified (SN: 4/14/73, p. 245).

Thanks to this research, slow viruses have since been tentatively identified as the cause of some other neurological diseases as well. In nominating Gajdusek for the Nobel Prize, NIH characterized his work as "a major breakthrough and discovery that has revolutionized thinking" about "a large group of neurological diseases of unknown etiology."

During the 1960s Blumberg, in contrast to Gajdusek, was studying blood serum samples from some 100,000 persons from various cultures to learn why certain ethnic groups are prone to certain diseases. The serum of an Australian aborigine provided him with a particularly interesting lead, a protein that he called the "Australian antigen." He subsequently found that although some 10 percent of the Far East population carries the antigen, Europeans and Americans rarely do unless they are sick. Still further research provided him with an unexpected and important discovery—that the antigen is part of the virus that causes hepatitis B, the most severe form of hepatitis, and that it is the antigen that provokes antibody responses to the virus.

This disclosure set the stage for screening blood donors for hepatitis (SN: 6/13/70, p. 584). It also allowed Saul Krugman and Joan P. Giles of New York University School of Medicine to use the antigen to develop a vaccine against hepatitis B. They showed the vaccine's effectiveness in a small number of persons in 1971, and in still more by 1973 (SN: 4/21/73, p. 155). The vaccine is now being produced by Merck and Co. for experimental use. Blumberg and vaccine authorities predict that the Food and Drug Administration will approve the vaccine in another two or three years (SN: 12/14/74, p. 38). □

Chemistry: Structure of borane compounds



Lipscomb and diborane molecule.

Wide World

Research on molecular structure and chemical bonding is the basis of the 1976 Nobel Prize in Chemistry, awarded to William N. Lipscomb of Harvard University.

Since 1949 Lipscomb has worked with compounds called boranes, which are made up of boron and hydrogen atoms. Chemists did not understand how the atoms were linked together in these molecules, because there didn't seem to be enough electrons. Most chemical bonds are formed by one or more pairs of electrons between each pair of atomic nuclei. But in diborane (B_2H_6) for example, only two electrons apparently make up two bonds, linking each central hydrogen to two boron atoms.

Lipscomb examined the structure of boranes by observing the pattern of deflections of X-rays beamed at a pure crystal. This work was done at low temperatures because boranes are often explosive. Lipscomb discovered that complex borane molecules were polyhedral structures, with boron atoms at the corners.

By studying the simpler boranes, Lipscomb and co-workers described a "three-center bond" by which two electrons connect three nuclei. Extensions of this description have allowed Lipscomb to predict structures of new, more complex boranes and reactions of boranes with other compounds.

Lipscomb is now working primarily on the structure of proteins. Other researchers are doing preliminary studies on the use of boranes in cancer therapy. □

Viking: Perplexing data, icy imagery

Ice-draped cliff near edge of Martian north polar cap: Like fingers of ice on a window pane.

NASA/Viking 2

The Viking mission to Mars has in the past week produced more bizarre results from the landers and some striking photographs of the Martian poles from the orbiters.

Two of the major question marks come from the biology instruments aboard lander number 2. The labeled-release experiment, designed to seek signs of metabolism by monitoring the release of gases containing carbon-14 from a labeled nutrient, was studying a soil sample that had been "cold-sterilized" at 50° to 55° C. Previous tests with lander 1's instrument had shown a high, smooth release curve from unsterilized soil and a low curve from soil sterilized by three hours of heating at 160° C. This had suggested either a life form that was killed off or a nonbiologic, chemical process that was somehow deactivated by the heat. The lower sterilization temperature in the latest run was supposed either to point to biology (which should be more heat sensitive) or else reduce the nonbiologic alternatives by limiting them to processes that would be altered at the lower temperatures.

The result was perplexing. The curve was lower by at least 60 percent than that of the earlier, nonsterile run, but it was still substantially higher than that from the fully sterilized sample. "The biology does not appear to be eliminated," says LR coinvestigator Patricia Straat of Biospherics, Inc., "and we would conclude that the chemical range of possibilities has been narrowed." But, she warns, "again we have a ways to go before we can rely on the interpretation of the data." One reason is the shape of the curve itself. Instead of following a smooth course like the previous runs (both sterile and otherwise), it is a jagged, up-down-up-down sawtooth shape, suggesting, says Straat, "some very peculiar kinetics that at the moment we really don't know how to interpret." One possibility is that some electronic problem has caused the carbon-14 detector to vary in its sensitivity with the small temperature variations that are always taking place within the instrument. But it's still a mystery.

Another unusual result turned up in lander 2's pyrolytic-release experiment, which exposes its samples to gases containing carbon-14 to see if microorganisms are assimilating carbon from the atmosphere. The latest cycle, says Norman H. Horowitz of the California Institute of Technology, was run "with all cannons blazing." The sun-simulating xenon lamp (left dark in the previous cycle) was on, and for the first time a sample was moistened with about 100 micrograms of water vapor, in hopes of compensating for the fact that the sample was gathered at a warmer, drier time of day than the sample that produced the exciting, "positive" results in the first cycle aboard lander 1. The first of the latest cycle's two data peaks, which reflects the efficiency with which excess gaseous carbon-14 has been flushed from the system, was the highest ever recorded by either lander: more than 12,500 radioactivity counts per minute. Yet the key second peak was the lowest ever, 0.69 counts per minute or, says Horowitz, "essentially zero." Adding to the confusion was an indication that a possible leak in the instrument's radiation counter may have been letting gas escape from the system, thus lowering the count. But even corrected for that, says one Viking biologist, the level seems to be only about 2 to 3 c.p.m. "The most obvious and most probable explanation," according to Horowitz, "is that the injection of water vapor actually destroyed the capacity of the soil or the surface material to do the organic synthesis that it was doing previously." Yet the supposedly naturally moist soil in lander 1's first test yielded a second peak of 96 c.p.m. Heat could be a factor—the latest test was about 5° C warmer than most of the earlier runs—but one lander 1 cycle produced a second peak of 28 c.p.m. despite an operational error that exposed its sample to a temperature that was 8° C higher still. The biologists' task is getting no easier, and Viking's continued failure to detect naturally occurring organic materials is not helping.

An important goal of the "walk" of orbiter 2 was to permit close-ups to be taken of the Martian north polar cap, which was only poorly seen by Mariner 9. "These," says Carr, "lived up to their expectations." Huge, dark gashes slice across the cap's stark whiteness, signs of seasonal—and sometimes epochal—melts and flows. Sweeping, curved ice fronts, some adorned with frozen fingers like ice traces on a gigantic window pane, stand cliff-like in apparent relief (although, Carr says, it is often difficult to tell without stereo images "what is up and what is down"). Perhaps most intriguing of all in the crisp photos, however, is the clearly defined layering. Ice . . . dust . . . ice