the chance for a united Europe, for example, and world government.

Their ideals are impeccable, says Dr. Maslow; their means, as in the Columbia incident, are stupid.

But if young people espouse new ideas, they did not create them, says Dr. Unwin, who believes sympathetic adults attribute to adolescents more certainty and moral strength than they really possess.

They are a "very bright, healthy mob," he says, but also unformed. The ideas behind youth protests are being articulated and thought out by older philosophers such as Paul Goodman, author of "Growing up Absurd" and Herbert Marcuse, professor at the University of California, San Diego, as well as Timothy Leary, high priest of the LSD movement.

Meanwhile adult society leaves kids "very much to continue what they are doing," says Dr. Unwin. Try to set up something to help hippies and it is sabotaged by adults, he declares. He says organizations carrying medical and nutritional help to hippie groups have been "blown apart."

Parents are disgusted when their children use marijuana, Dr. Unwin adds, yet two months later, they are asking for it themselves. This does not happen every day, but "I've seen it enough to amaze me."

Adults sense the need for new ways of thinking and acting, he continues, and are "using the elasticity of kids to test them out." ◇

ASTRONOMY

An optical pulsar

The astronomical radio sources which pulse about once a second fascinate astronomers: they reflect physical processes going at an exceptionally fast rate. Four such pulsars are now known to exist (SN: 3/16, p. 255).

Since the discovery of the first in July 1967 by Dr. Anthony Hewish and four co-workers at Cambridge University, theorists have supplied numerous speculations to account for the quick variations — pulsating neutron stars, white dwarfs and rotating binaries, among others.

Now the theorists will have to work even harder. They will have to fit into their theories pulsations in visible light that observers believe they have found in at least one pulsar, Dr. Hewish's first, which is now catalogued as CP 1919.

Searches for optical signals—and especially pulsed optical signals—from pulsars have been going on for several months. Some observatories report no success, but teams working at the Lick Observatory in California and at the Kitt Peak National Observatory in Arizona during late April and early May have succeeded in detecting extremely faint optical pulsations in CP 1919, which is located in the constellation Vulpecula.

News of the discovery was first communicated to interested astronomers May 20 at the Goddard Institute for Space Studies in New York City. The report, by Dr. Stephen Maran of Kitt Peak, caused an immediate uproar among the theorists.

The next day, Dr. David Cudaback of Lick Observatory flew in to report on the California observations which had been made only a few weeks before. The results were still in a rough form. Dr. Cudaback had been at the computer all night for several nights. Finally he decided to fly to New York because this gathering of astronomers interested in pulsars was the most fitting place to report the unexpected results.

The observations at Kitt Peak, by Dr. Maran, Dr. Roger Lynds and Donald Trumbo, were made with the observatory's 84-inch telescope. The California work, done by Dr. Cudaback, Dr. Leonard Kuhi, Ned Conklin and Taylor Howard, involved simultaneous observations with the 120-inch optical telescope at Lick and the 120-foot radiotelescope at Stanford University.

The optical fluctuations are far too faint to be distinguished from background light by using any existing telescope. The only way to discover the wave-like pulsation was to store and add up photomultiplier-tube data from a large number of cycles.

The Kitt Peak group assumed that the optical period would be twice the 1.3-second radio pulse. To accomplish the storage and the adding, they divided the known period of a radio fluctuation into 400 subperiods. The light intensity seen by the telescope in each subperiod was recorded and stored in a different element of an electronic memory. As each one-second period went by, the brightness from the first 400th part went to memory element 1, that from the second 400th part to element 2 and so on. Over thousands of periods background light would build up evenly in all 400 elements, but any periodic fluctuations would show up as much greater intensity totals in particular memory elements. And that, in fact, is what happened, reports Dr. Maran. Differences too small to see in one cycle added to noticeable totals in thousands of cycles.

The California observers did not assume any particular relationship between radio and optical periods. From the output of their photomultiplier tubes they generated an electrical current that would represent changes in the brightness of the light and examined this for low frequency fluctuations. The radio pulses are constant, but the rates of optical pulses were found to vary. This was a surprise because optical pulses had been expected to have rates as constant as the radio ones.

The two observations do not necessarily conflict, says Dr. Cudaback, since the method used at Kitt Peak would have suppressed evidence of fluctuations at any frequency but the selected one.

Dr. Cudaback stresses the roughness of his data. The timing of the conference did not allow him time to work them over as thoroughly as he would like. "I may be dead wrong," he says, "but I don't think so."

Possible optical pulses from other pulsars are being investigated. Kitt Peak has looked at the one called CP 0950, but so far without result.

JAPAN JOINS CLUB

Proliferation of plutonium

As debate on the nuclear non-proliferation treaty continued in the United Nations last week, news that Japan has produced bomb-quality plutonium without foreign technical assistance underlined the importance of quick action if the treaty is to be effective. Several other nations, including India, have already produced plutonium.

The Japan Atomic Energy Research Institute disclosed production of 18 grams of plutonium 239 of an estimated 95 percent purity at its Tokai Village laboratory, 70 miles northeast of Tokyo.

The successful reprocessing of used uranium reactor fuel means Japan now has technical potential to make an atomic bomb with domestically produced Pu-239. The institute termed the first home made weapons-grade Pu-239 an experimental sample. The experiment began last March in the Tokai laboratory.

Pu-239 is one of the two sources of nuclear energy for atomic bombs, the other being uranium 235. Plutonium is an artificial element created in atomic power reactors as a by-product of the fission of uranium; when used uranium fuel rods are withdrawn from reactors for reprocessing, the plutonium can be extracted.

Control of plutonium produced in booming nuclear power plants around the world, including international inspection, is a central aim of the non-proliferation treaty.

Under her own law, which limits the

use of atomic energy to peaceful purposes, Japan cannot make nuclear weapons. The plutonium produced, says the institute, will be used for research into fast breeder reactors to be used for power generation in the future.

Eleven used fuel rods were reprocessed using domestic equipment. Of the 90 kilograms reprocessed, about 27 grams contained plutonium. The used fuel had been taken from Japan's first homemade reactor, the JRR-3.

Recovery rate was about 70 percent but this could be boosted to 90 percent in the next experiment, slated for mid-July. In this, the laboratory expects to obtain 100 grams of 95 percent Pu-239. Japan is building a reprocessing plant which would handle much larger quantities of fissionable material.

Japan, the institute says, has "no intention of stockpiling the processed plutonium, but instead will make it all available for international inspection."

Observers do not deny possible international repercussions of the Japanese development.

"Notwithstanding Japan's peaceful intentions," explains one foreign government science attache, "the nation's latest success in producing Pu-239 without foreign technical aid clearly shows its nuclear arms potential."

THE AVAILABLE TECHNOLOGY

Re-measuring gravity

The acceleration due to gravity is a pivotal quantity in several areas of precise measurement. It enters directly into the determination of the ampere as an electrical standard, into standards of force for calibrating load cells that measure rocket thrust and into standards of fluid pressure.

Geophysicists studying the size and shape of the earth are especially interested in how g varies from one place to another, since this is a clue to the distribution of earth's mass.

Measuring the acceleration of gravity has challenged men's curiosity since Galileo discovered that the distance a falling body travels from rest varies as the square of the time.

Galileo's use of slopes between 5 and 10 degrees to determine the acceleration of balls of different material down a smooth inclined plane took full advantage of the experimental means at his disposal. He concluded that "in a medium totally devoid of resistance, all bodies would fall with the same speed" (see page 532).

The most recent method for determining the acceleration of gravity also takes advantage of the available technology in length and time measurements, but of a freely falling body. The completely automated apparatus developed by Dr. James E. Faller and graduate student James A. Hammond of Wesleyan University, Middletown, Conn., uses a stabilized helium-neon laser as the light source in a Michelson-type interferometer, with a freely falling corner reflector as one of its mirrors. The time and distance measured are printed out on computer tape.

A corner reflector, a mirrored equivalent to the section where two walls and a floor meet, has the advantage of reflecting a light beam directly back to its source (SN: 6/5/65, p. 355).

The freely falling corner reflector, contained in a high vacuum chamber to reduce friction, drops about three feet. By comparing the laser wavelength with the orange line of krypton 86—the internationally agreed-on standard for length—a length scale accuracy of one part in 100 million can be achieved. Galileo had to settle for one part in 50.

The time base for the electronics is obtained from a highly stable crystal that oscillates at five million cycles, with its frequency being compared daily with the standard radio frequency broadcast by the National Bureau of Standards.

The instrument developed by Dr. Faller and Hammond is semi-portable; that is, it is designed for disassembly into units light enough to be carried by one or two men.

This makes it possible, for the first time since the classic pendulum experiments of Capt. Henry Kater in the early 19th century, to make absolute measurements with the same apparatus at a number of different sites.

So far the instrument has been used to determine the acceleration of gravity only at Middletown, Conn., and at the National Bureau of Standards in Gaithersburg, Md. Dr. Faller plans to take it to England in late July for measurements at the National Physical Laboratory, Teddington, and then to the Bureau International des Poids et Mesures in Sèvres, a suburb of Paris.

The NBS measurements were made in mid-May. Dr. Faller says "a first look at the data" indicates that the acceleration of gravity at NBS Standards II is 980.1013 centimeters per second in each second of fall. The value obtained by Douglas R. Tate in 1966 was 980.1018 centimeters per second (SN: 1/28/67, p. 94), in good agreement."

Trucks and automobiles combine with the general microseismic background to create disturbances that can distort the measurements. The instrument is, therefore, equipped with a long period seismometer, whose readings make it possible to correct for these seismic disturbances.

QUAKE MAKER

Army to depump Denver well

Within a month after the Army drilled a 12,000-foot-deep hole in the ground to dispose of chemical wastes at its Rocky Mountain Arsenal near Denver, Colo., the area began to be shaken by earthquakes, their numbers rising and falling in near-perfect correlation with the Army's pumping into its well.

After four years of this, there seemed little doubt that the well was some new kind of quake-maker, and the Army stopped pumping in February 1966. The quakes, however, kept right on happening, causing debate as to whether the pumping had been causing the tremors after all (SN: 5/4, p. 434).

The inevitable suggestion was that perhaps the Army ought to try pumping the fluid out again. This was opposed, often rather hotly, by many residents and several geologists with the Colorado School of Mines, among others, who suggested that since the Army didn't know what it was getting into the first time, it should leave its monster well enough alone. Removing such a huge volume of fluid (3,829,181 barrels) from the ground might alter subterranean pressures enough to cause a major quake.

Now the Army Corps of Engineers has announced that it is going ahead with a series of test pumpings, to see if it is possible to get the fluid out of the well.

It may not be; it was tried before. On Sept. 22, 1961, when only a few thousand barrels of fluid had been pumped down, engineers tried, as an experiment, to get some of it back. The pumping rate soon began to drop off sharply, until in a little more than a month it had shrunk from 200 barrels a day to 25. At that rate it would have required more than four centuries to extract all the fluid from the well. The likeliest explanation for the drop is that removing some of the fluid allowed the cracked rocks at the foot of the well to settle back together, closing off fissures that had been opened when the fluid was pumped in.

The Corps of Engineers' new test will have to wait until at least mid-July because of experiments begun last week by the Geological Survey, with an elaborate instrument package in the well to take seismic, pressure and other data.

Once the Corps gets its well back, it will follow a careful schedule in pumping out small amounts of fluid, with seismographs for miles around set to pick up the slightest disturbance that might result.