But his real problem, he says, is whether "the new generation regards my book now as establishment economics. And that's why in the eighth edition I've worked so hard to get all the smugness out.

"If you are young and believe the system ought to be destroyed and a better system built, just to describe carefully how the system functions seems to take on an air of apologetics. I'm stubbornly unrepentent on that, but there really is an issue there." □

RADIOACTIVE DECAY

A fourth method

Univ. of Calif.

Cerny (r) and team: Proton decay.

Nuclear physics began with the observation that some chemical elements can spontaneously, without ouside interference, transmute themselves into other elements by radioactive decay. Observers in the late 19th century discovered two such processes: alpha decay, in which a nucleus emits an alpha particle or helium nucleus, and beta decay, in which a neutron inside a nucleus turns into a proton, and the nucleus emits an electron and an antineutrino.

Since an alpha particle contains two neutrons and two protons, its emission decreases the atomic weight by four and the atomic number of the nucleus by two. Beta decay increases the atomic number by one.

In 1938 a third method, spontaneous fission, in which certain nuclei split more or less in half, was discovered.

This week the observation of a fourth method of spontaneous nuclear transmutation by radioactive decay, predicted by theory but not before seen, was announced. Called proton decay, it is a process in which a nucleus emits a proton and decreases both atomic number and atomic weight by one.

Besides confirming theoretical predictions that proton decay should exist, the experiments should lead to a new precision in analyzing what goes on within the atomic nucleus.

Proton decay was first observed at the nuclear physics laboratory at Harwell, England, last year, but the result was not considered conclusive. It was then confirmed this summer at the Lawrence Radiation Laboratory in Berkeley, Calif. The work was initiated by Dr. Joseph Cerny, associate professor of chemistry at the University of California at Berkeley, who was on sabbatical in England. There he worked with three Canadian scientists, Drs. K. P. Jackson, C. U. Cardinal and H. C. Evans, and an Oxford University graduate student, N. A. Jelley. Later at Berkeley, Dr. Cerny worked with Dr. R. A. Gough and graduate students John E. Esterl and R. G. Sextro.

Proton decay had been predicted by theorists for some time, but it was not observed until now because it will happen only in nuclei that are seriously deficient in neutrons. Such nuclei do not exist naturally; they have to be manufactured.

In the experiments at Harwell nuclei of calcium 40 were bombarded with nuclei of oxygen 16. In the collision, two free neutrons and a free proton came away and the remaining matter fused into nuclei of cobalt 53m. At Berkeley cobalt 53m was made by bombarding iron 54 with protons. (The letter "m" refers to a metastable state, one in which the nucleus has a large amount of energy and keeps it for a long time instead of radiating it away quickly.)

The cobalt 53 nucleus has six neutrons too few for stability, and this large deficiency means that there is an essentially loose proton in the nucleus. This proton, says Dr. Cerny, is not bound by the strong nuclear force that holds all the other neutrons and protons together. It is held within the nucleus only by a barrier set up by electromagnetic forces and the ways in which the spins of the nuclear particles combine with one another.

The loose proton never has enough energy to get over the barrier, but after various lengths of time, the loose protons in different cobalt 53m nuclei find their ways through the barrier by a process peculiar to the behavior of subatomic particles called quantum mechanical tunneling.

According to Dr. Cerny, proton decay should be very useful to students of nuclear structure. The emission of a single proton presents a much simpler situation than the emission of a four-particle complex in alpha decay or the numerous fragments of spontaneous fission. The mathematical description of the simpler process should be easier to calculate, and that, says Dr. Cerny, will aid scientists "to learn sensitive details of nuclei." □

INSECTICIDE GUILTY

Death of the bees

Dead bees covered the ground in front of hives. Others, paralyzed, took several days to die. Some performed grotesque communication dances on the landing board at the hive entrance, whereupon they were refused admission by guard bees. A few still able to do normal dances made it into the hive. But their body hairs, so precisely adapted for picking up pollen, now carried dusty death to the brood inside. The powerful queen, helpless against disaster, was deposed by swarms of frenzied workers. Soon the entire hive died.

As catastrophe struck the bee colonies, perhaps the most tightly organized of nature's societies, Minnesota beekeepers erupted like a swarm of angry hornets in the direction of the Jolly Green Giant and other large canners. The death of bees in enormous numbers is the result of a recent switch by canning companies, who are the largest vegetable growers, from DDT to an insecticide thought more benign, carbaryl.

It was a bad September for bees in Minnesota. Dry weather shriveled many of the clover and alfalfa blossoms from which bees draw nectar and the bees have ranged ever deeper into the sweet corn fields. Here they got what may have seemed miracle food—carbaryl, applied to check the corn earworm and borer, had been mixed with molasses for adherence to the corn.

There was also a new predator. A small green moth, relative of the cabbage looper, was blown in on winds from the South. The moth seems to prefer the succulent peas of the Green Giant Co. of Le Sueur, Minn., to anything it can find down South. It does not greatly damage pea crops, but does fold its wings and crumple into a pea-sized ball. This protective masquerade has caused it to turn up in pea cans. While local entomologists say the moth is high in vitamins, it distinctly lacks consumer acceptance and pea growers have been using carbaryl as enthusiastically as corn growers.

In mid-October, Minnesota beekeepers met with representatives of three large canneries in the first of a series of meetings that they hope will produce a way to save the bees. More is at stake than honey. Alfalfa is a big cash crop that requires bees as pollinators. So do fruit trees, squash, legumes and a host of other crops that nationally amount to some $1 billion worth of agricultural products a year.

"We think better understanding of the essential agricultural role of bees will persuade insecticide-users to take every step possible to protect these

hard workers," says Clare Floyd, in charge of bee affairs for the Minnesota Department of Agriculture and himself a beekeeper. The late corn crop is the big problem (insect population does not build up enough to require insecticide treatment of earlier crops) and the canners are working on a plan to plant the late crop as far as possible from fruit trees and other crops favored by bees.

Bees have an elaborate nervous system built into antennae, mouth parts and other organs highly specialized for their aerial life and intricate labors. This makes them highly sensitive to the modern neural-acting insecticides. So many bees have died since widespread use of DDT began around 1940 that growers are now obliged to rent bees as pollinators. Such rental fees are a bigger source of income to beekeepers than honey, whose price has remained at an uninflated 11 cents per pound wholesale for more than a decade.

Carbaryl, produced by the Union Carbide Corp. and trade-named Sevin, is also used widely by small home owners as a component of yard sprays purchased over-the-counter. When DDT was outlawed because of its long-lasting residues in the tissues of most species, organophosphorus compounds, similar in biochemical action to the deadly nerve gas invented for military use (SN: 8/15, p. 137), were the first replacement. Occasionally lethal to humans because they are absorbed through skin and irreversibly paralyze a key enzyme of the nervous system, the organophosphates (Malathion and Parathion are examples) are being replaced voluntarily by users aware of their hazards. Carbamates (Sevin is the best known) are the replacement.

For bees, Sevin is more dangerous than the organophosphates it replaces. The latter break down rapidly; beekeepers cover up their hives to keep bees at home for three days. Sevin does not break down for two or three weeks.

The problem is not confined to Minnesota. Late-planting zones established in the state of Washington failed to save the bees there. In the Yakima Valley, where 80,000 acres of fruit trees grow near 40,000 acres of sweet corn, beekeepers count losses of more than $700,000 as a result of heavy use of carbaryl in recent years. Losses are also heavy in California and Arizona, where carbaryl is used against the pink cotton bollworm.

"We have great hopes of eventual solution by means of sterilization and biological control of harmful insects," says M. D. Levin, chief of the U.S. Department of Agriculture's apiculture research branch. "In the meantime we are trying to develop insecticide-resistant strains of bees and to provide insecticide-free bee sanctuaries." □

GENERIC EQUIVALENCY

Testing the me-too drugs

A fair portion of the drugs on any pharmacist's shelves are what the trade calls me-too products, agents which are claimed to be identical to some brand-name drug. Often these so-called generic equivalents are less expensive than their brand-name counterparts. Frequently they appear shortly after the original manufacturer's patent expires.

There is little doubt that me-too products are, in fact, chemically identical to the original drug they are trying to compete with in the marketplace. But whether me-too drugs are biologically equal to the brand-name original is another matter. Indeed, the question of generic equivalency has long been one of the most hotly contested issues plaguing the drug industry and the Food and Drug Administration (SN: 4/22/67, p. 381).

After years of debate, open admissions by FDA commissioners that generic equivalents may not be equivalent at all and excuses that the complexities of the situation make dealing with it virtually impossible, the FDA is quietly but surely taking steps to guarantee that claims of equivalency can be supported, at least for all new products.

According to FDA Commissioner Charles C. Edwards, the agency finds that "comparable bioavailability frequently does not exist for products that are otherwise, so far as currently available methods are concerned, identical." In other words, two like antibiotics may contain precisely equal amounts of active ingredient, but because of differences in manufacturing procedures in formulating a tablet the active antibiotic may be released faster and in greater quantity from one tablet than from another.

In a limited but first step in coping with the problem, the FDA has issued a policy, in the form of a directive from Dr. Henry Simmons, Director of the Bureau of Drugs, "to determine the comparative biological availability of these drugs."

At present, the regulation is only prospective, applying to products currently up for consideration but not retroactively to those already approved. The demand it makes of manufacturers is relatively simple.

The ideal way to determine that two like products are equal in therapeutic action would be to compare them in extensive, double-blind clinical studies. However, the cost, time and skilled manpower required for such investigations is prohibitive. So the FDA is asking for the next best thing—tests of bioavailability to show that the active ingredient in me-too products is as available, once inside the body, as the original brand-name drug.

According to Dr. J. Robert Weinrogh of FDA, this can be demonstrated effectively by one of two methods. The most satisfactory involves giving compounds to human volunteers and then measuring drug levels in blood. But this becomes difficult, if not impossible, with compounds administered in minute quantities. Technically it may not be feasible, for instance, to detect blood levels of drugs given in one milligram dosages. In that case, dissolution tests are considered indicative of bioavailability. Compounds are exposed to synthetic gastric or intestinal juices in the laboratory to determine the speed and thoroughness with which a tablet or capsule is dissolved and the active ingredient released.

The FDA's new requirements are clearly neither the perfect nor total solution to the problem of guaranteeing that two or more allegedly equal products are genuinely comparable. But agency officials feel that a limited step in the right direction is preferable to doing nothing at all. □

SCIENCE NEWSBRIEFS

Icebreaker not economical

The Humble Oil and Refining Co. has announced that it is suspending its icebreaking-tanker studies to explore other ways to transport crude oil from Alaska's North Slope to markets in the United States. Two voyages by the super-tanker Manhattan (SN: 4/25, p. 420) demonstrated the operational feasibility of transporting the oil by ship through the ice-clogged Northwest Passage, company spokesmen said. But the company has decided that use of pipelines now appears more promising economically. □

Accelerator site

The council of CERN, the European international physics laboratory, has approved a plan to build a proton accelerator of 300 billion electron-volts energy on a site across the road from its present laboratory in Geneva. The new plan (SN: 6/27, p. 615) replaces one under which the new accelerator would have been built on a different site and which foundered on disagreements over finances and site selection. □

Flight of Zond 8

The unmanned Soviet moonship Zond 8 splashed down in the Indian Ocean this week after a 500,000-mile flight around the moon. Launched Oct. 20, Zond 8 studied the lunar atmosphere and photographed the surface as it swung around the moon last Saturday, the Tass news agency said. □