BIOCHEMISTRY

Green Plant Secret Sought

Both U. S. and U.S.S.R. seek nature's secret, photosynthesis. If and when scientists solve the puzzle, synthetic production of food might be possible.

➤ CARBON 14, radioactive form of the fundamental life element, is being used by both Russian and American scientists to force nature to part with the secret of photosynthesis.

The still unsolved problem of how plants build complex chemicals, the world's basis for all food supplies, is potentially a greater research goal than the problem of how to use atomic energy, the prime topic of the International Conference on the Peaceful Uses of Atomic Energy in Geneva.

Russian scientists T. N. Godnev and A. A. Shlik stressed the early stages in the formation of chlorophyll, the green pigment that houses the plant's secret food factory. By keeping plants in an atmosphere of carbon dioxide made of radioactive carbon, the Russian scientists were able to measure the rate of the plant's use of carbon atoms and to calculate that the average length of life of a molecule of chlorophyll is approximately 19 days.

The dawn of a technology that may provide future generations with food aplenty was foreshadowed by two University of California scientists who said they have completely illuminated one of the two major phases of photosynthesis.

They have discovered a new and unique enzyme chemical playing a part in the first, key step in the photosynthetic cycle.

The scientists described every step of the complex chemical cycle that begins when plants absorb sunlight, carbon dioxide and water; and ends when these simple ingredients are turned into sugars, starches and other energy foods.

A "Handle," Carbon 14

When Hiroshima was cremated, this chemical cycle was almost a complete mystery. And there was no way scientists could substantially penetrate the dark mystery surrounding the subtle reactions.

But when World War II ended, American scientists were given a wonderful "handle" on the mystery, carbon 14.

Dr. Melvin Calvin of the University of California and his associates put single-celled marine plants into test tubes, gave them water, and exposed them to light and radioactive carbon dioxide. Then they killed batches of plants at different intervals—ranging from a fraction of a second up to hours.

After tearing the plants apart chemically and isolating each chemical compound, the scientists located the radioactive carbon by means of its radioactivity. By a process of deduction, they traced the radioactive carbon from one step to another all through the cycle, eventually determining the nature of each reaction.

Dr. Calvin, whose collaborator on the technical paper is Dr. J. A. Bassham, described each step in the cycle. There are 11 distinct (enzymatic) steps in which at least eight different enzymes participate. There are 11 intermediate compounds between the plant's intake of the simple ingredients and the formation of the energy compounds. (See SNL, Aug. 13, p. 101.)

The cycle in which these steps are arranged is like a flow pattern of a great assembly-line factory. The simple materials enter, they are moved along, changed and added to by enzymes and high-energy phosphate compounds.

Ironically, the first, key step in the cycle was the most difficult and the last one bared by the Bergeley researchers. Only recently have they been able to confirm the true nature of this reaction.

Isolate New Enzyme

In the process of exposing this key chemical reaction, the scientists isolated a brand new enzyme, carboxydismutase. It is the only unique enzyme in the photosynthetic cycle. All of the others are common ones found elsewhere in biological systems.

The two scientists indicated that the great remaining challenge of photosynthesis research is the determination of how sunlight is converted into the form of energy required to operate the chemical cycle. Years ago scientists determined that sunlight is captured by chlorophyll, the green pigment of the plant cell. But how it is converted remains a great mystery, and one that does not yield readily to study with radioactive isotopes.

Two possibilities for application are indicated:

First, it may be possible to use the knowledge of the chemical cycle to improve the efficiency of photosynthesis on the farm—for example, by altering conditions so as to give the plant longer life or to increase the yield of certain end products.

Very slight improvements in the efficiency of photosynthesis can yield tremendous returns. Plants grown on farms capture only about one percent of the sunlight that falls on them. If another percent of that sunlight could be captured and converted, the food supply would be tremendously increased.

Second, after the light conversion process is understood, some scientists say that photosynthesis factories may be built to duplicate the work of plants—to produce food synthetically, and more efficiently, and for the first time in history to liberate man from his parasitic dependence upon plants.

Science News Letter, August 27, 1955

BIOCHEMISTRY

Using Atomic Radiation For Foods And Drugs

➤ THE ATOMIC AGE with cheap, plentiful radiation from the wastes of atomic power plants, will see:

1. Preservation of food by cold sterilization, outmoding some canning and freezing of vegetables, meat, fruits, etc.

2. Sterilization of medical supplies, such as antibiotics, drugs and bandages, to make them safer after they are packed for shipment and use.

INSIDE JOB—A stretched rubber band usually breaks "from the inside out," General Electric researchers have found by examining high-speed photographs such as shown here. After the band has snapped, the ends fly apart at speeds up to 500 miles per hour.

3. Prevention of trichinosis, serious pork-borne disease, by irradiating hog carcasses.

4. Making bones, heart tissues and other materials from "banks" used in human replacement surgery safe for use by irradiating them with gamma rays from cobalt 60.

This was evident from reports to the International Conference on the Peaceful Uses of Atomic Energy in Geneva.

The cold sterilization of food promises to usher in as radical a revolution in food preservation as the invention of canning or heat sterilization. Profs. B. E. Proctor and S. A. Goldblith of the Massachusetts Institute of Technology told the conference ionizing radiations can destroy all sorts of microorganisms that cause spoilage in food. They can produce potatoes that can remain fresh for months and never sprout wastefully. Insects are killed by relatively mild doses of radiation, so that stray contamination is prevented.

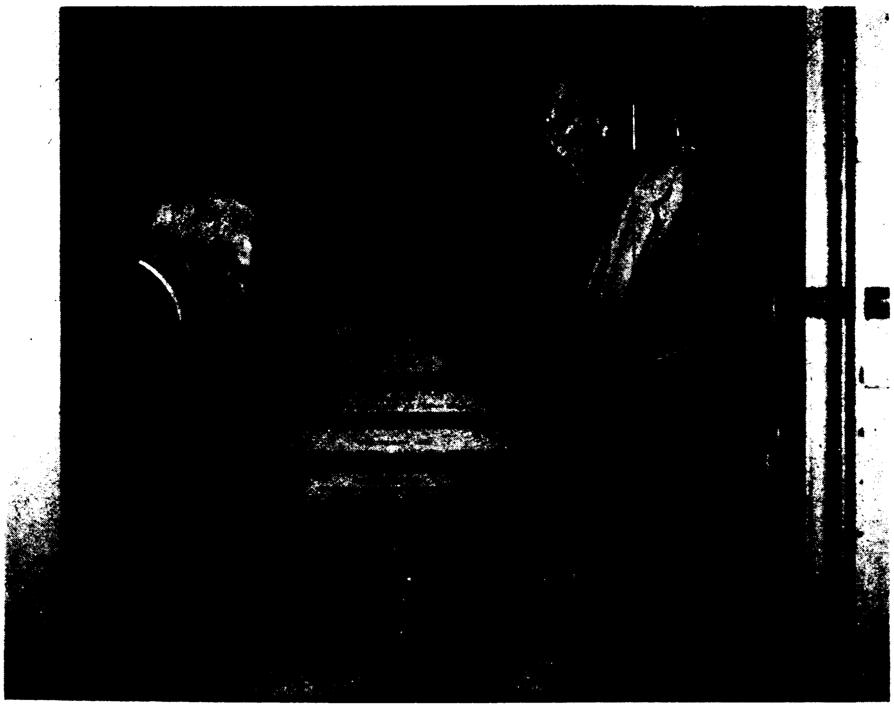
Even the changes in color, taste and texture that sometimes occur with heavy radiation may be obviated by treating food, when it is frozen, in an inert atmosphere, or by addition of materials that would pick up the undesirable materials resulting from the radiation.

Food sterilization will come into wide use commercially within a decade, it was predicted.

Bread, rolls, cake and other bakery products will be one of the first foods to be kept fresh by atomic radiation, R. G. H. Siu, R. G. Tischer and B. Morgan of the U. S. Army Quartermaster Corps told the conference. This application will follow shortly after the waste rays are used to obviate insect damage and prevent potato sprouting.

Over 30 human patients have received successful bone grafts from the University of Michigan Hospital bone bank which sterilizes the bones on deposit there with gamma radiation. Michigan studies also show that cold radiation sterilization can treat at one time a whole load of medical supplies in tightly closed containers, replacing the present standard sterilization method using hot steam that damages many substances.

Meat that may carry trichinosis and other dangerous parasites can be made safe by use of gamma rays from cesium 137 isotope, a by-product of atomic reactors. At a cost of less than a quarter of a cent a pound, one plant, designed at the University of Michigan, could process 2,000 hog carcasses per day, obviating the danger of this disease that has forced widespread emphasis upon cooking all pork thoroughly. For trichinosis there is no successful treatment for the human victim.



STANDARDS DISPLAY—The nation's standards of length and mass are now regularly on display for the first time in the newly modified standards vault at the National Bureau of Standards in Washington. Here, Drs. Lewis V. Judson (left), chief of the length section, and A. V. Astin, director of the Bureau, prepare the platinum-iridium alloy standards.

Clean Up Contamination

➤ USE OF ANIMALS and fish to clean up radioactive contamination around atomic power plants was suggested by scientists of the General Electric Company working at Hanford, Wash.

While the dangers near Hanford have been kept to a low level, with little contamination of the Columbia River whose water is used to cool reactors, the scientists are working out methods of getting rid of the poisonous fission products in case they do get loose on a large scale, either there or at other atomic plants.

The chemicals they are most worried about are the radioactive iodine isotope 131, strontium 90 and phosphorus 32. They are formed as a consequence of "burning" of uranium or plutonium.

Crops can be contaminated either by the radioactive material falling on the maturing plants or being deposited on the soil from which it is absorbed by growing plants. Then animals eat the crops. Radioiodine loses its punch within weeks, but radiostrontium remains a potential hazard for several years.

The strontium is concentrated in the bones of animals that eat food containing it. If an area is contaminated too much, J. H. Rediske and F. P. Hungate suggested, it might be possible to feed the crops grown on it to animals, let the strontium accumulate in their bones and then sacrifice the animals and store their bones for safety.

In a similar way, fish might be used to collect and store radioactive materials until they decay and become safe, R. F. Foster and J. J. Davis proposed for unusual situations. Birds concentrated large amounts of radiophosphorus picked up from contaminated rivers and swamps in their egg yolks, skeletons and muscles.

At Hanford atomically "hot" strontium is kept in large tanks until it cools down, but this might be highly expensive for atomic power plants.

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INVENTION

Pioneer Atom Inventions Receive Patents

➤DR. ENRICO FERMI, the late Nobel Prize winner in physics, and Dr. Walter H. Zinn, director of Argonne National Laboratory, received patent No. 2,714,577 for a nuclear reactor that has a cooled shield, a composite rod for use in the reactor's active core, and a method for introducing foreign materials into the reactor's active part for neutron bombardment. At the same time, Dr. Zinn received patent No. 2,714,-668 for a simple device that responds to neutrons from the reactor to act as a safety regulator.

Both inventions are an integral part of the celebrated nuclear reactor invented by Drs. Fermi and Leo Szilard that heralded the atomic age.

Patents for the early atomic inventions were applied for in 1945, and were issued ten years later. Rights for the atomic devices were assigned by their inventors to the U.S. Atomic Energy Commission.

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