BIOLOGY

Bacteria Make Amino Acid

A new photosynthetic process has been discovered, biologists learned at their annual meeting. They also heard reports on a plant virus vaccine and the effects of radiation.

➤ A SECOND METHOD by which plants can use the energy of the sun to manufacture food and hence sustain all life on earth has been discovered.

This heretofore unknown photosynthesis process is a shortcut that by-passes the making of sugar and produces protein directly through light energy. It is accomplished by the world's most primitive food factory, organisms known as the photosynthetic sulfur bacteria.

The discovery of the process, which might also exist in higher plants, was reported to the American Institute of Biological Sciences meeting in Palo Alto, Calif., by Dr. R. C. Fuller and I. C. Anderson of the biology department, Brookhaven National Laboratory, Upton, N. Y.

Until now, the scientists explained, there has been shown only one method by which all plants fix carbon dioxide, using the energy of the sun to make sugar and then protein, fats and the other metabolic necessities of life. The method involves adding the carbon dioxide to a sugar phosphate known as ribulose diphosphate. This complex is then split and synthesized into a molecule from which the higher plant builds starch.

The tiny photosynthetic sulfur bacteria are not only capable of using this method for food production, but can also use an alternate method.

It is the discovery of the alternate method that the two scientists have reported.

In the second and newly found photosynthesis process, the bacteria "fix" carbon dioxide onto a three-carbon acid called phosphoenolpyruvic acid to form a four-carbon acid that rapidly becomes another four-carbon amino acid—aspartic acid.

Aspartic acid, the scientists noted, is a basic building block for proteins.

Hence, the primitive plant has the ability to use not only the "regular" method for fixing carbon dioxide, but it can "fix carbon dioxide in a second way which does not make sugars but is a direct method for the production of protein via light energy."

Speculating on the possibility that this second system of fixation might also play a role in the photosynthesis of higher plants, the scientists said that all the enzymes necessary have been found in higher plants. However, the equilibrium seems to be more toward the synthesis of sugar, they noted.

Several Russian workers, Dr. Fuller and Mr. Anderson reported, have recently hinted there is a direct "pathway of the fixation of carbon dioxide for the direct synthesis of proteins as a function of light which occurs in the roots of plants.

"Certainly this system in these primitive bacteria may be the mechanism by which this is going on."

The Brookhaven scientists cautioned that much work is still needed to determine just how these primitive plants convert sunlight into chemical energy in the form of high energy phosphate, but concluded that the bacteria may also present science with a "far simpler system to help understand the actual mechanism" of the conversion.

Plankton Spread Fallout

➤ PLANKTON, tiny sea plants and animals, can provide scientists with a measuring stick for determining the effects of A- and H-bomb radioactive fallout on life in the Pacific Ocean, Dr. Lauren R. Donaldson, director of the University of Washington's Applied Fisheries Laboratory, told scientists at the meeting.

These near-microscopic organisms concentrate the ocean's radioactivity by taking in radioactive materials. They also control the rate of the radioactivity's westward drift since they move much slower than the water, or about half the speed of the North Equatorial Current of the Pacific.

The results of two pioneering oceanographic surveys in which fallout radioactivity from nuclear test shots was traced across nearly 500,000 square miles of Pacific waters were reported for the first time. (See p. 147.)

One of the unique findings of the surveys was the source of the radiation detectable in plankton samples. Radioactive iron, manganese, cobalt and zinc, non-fission products in which radiation had been induced by H-bomb or thermonuclear explosions, accounted for 90% to 100% of the radiation detectable in some samples.

Dr. Donaldson said his studies seem to show that the products of nuclear fission decay or are rapidly lost in the ocean. Non-fission isotopes, the products of induced radiation, are of "controlling significance in aquatic radiobiology."

Hundreds of samples of plankton and water were taken for the surveys, which had been requested by the Atomic Energy Commission's division of biology and medicine. The surveys were conducted during and after the operation Redwing series of nuclear tests at Bikini and Eniwetok. One was made in June, 1956, while the tests were in progress, the other in September, six weeks after the tests were completed.

During the June survey the average value for radioactive material found in plankton was 7,100 times the average surface water value. In September the average ratio of plankton activity to sea water activity was 2,500 to 1. June sampling showed radioactivity was "well within" the test area; by September the fringes of the tagged water mass, with faintly detectable activity, were some hundreds of miles westward toward Guam.

Plankton, found floating or weakly swimming in the ocean, are of particular interest to radiobiologists since they are the base of the oceanic food chain. They are a food source for larger fish that in turn are eaten by humans.

Plant Virus "Vaccine"

➤ U. S. ARMY scientists have perfected a "vaccine" from rice for protecting plants against virus infections. It might also be effective against viral diseases in humans, scientists at the biologists' meeting were told.

The disclosure that extracts from rice plants can inhibit the growth of some plant viruses came at a time when most Americans are worried about getting a vaccine to protect themselves against the Asian influenza virus.

Cautioning that the promising plant "vaccine" has been successful in laboratory and greenhouse experiments only, Army scientists Lt. Thomas C. Allen Jr. and Dr. Robert P. Kahn said that they have high hopes their find will have widespread use.

A majority of the experiments were conducted by inoculating Pinto bean plants with tobacco mosaic virus. Some of the plants were then dipped into solutions containing rice extracts. In most cases, the treated plants grew and remained healthy while untreated plants died or were severely damaged.

The Fort Detrick, Md., scientists used

MEASURING RADIOACTIVITY—Dr. Arthur D. Welander of the University of Washington takes a sample of below-surface waters by using a Nansen bottle. Designed to close automatically at different depths, the bottles provided samples at 75, 150, 225 and 300 feet at each station during a mid-Pacific survey of radioactive contamination of ocean waters. Samples of plankton were taken.

different parts of several varieties of rice, including "juice" from crushed leaves, and rice polish, the by-product remaining after rice kernels are milled. The rice polish proved most effective.

Lt. Allen and Dr. Kahn also experimented with other viruses on the Pinto and Black Valentine bean plants and reported up to 100% inhibition of the disease.

They noted that the following implications can be attached to their discovery:

1. Rice polish amounts to an "immunizing" of beans under greenhouse conditions against several types of virus diseases, much like preventing disease in humans and animals by vaccination.
2. It might prove to be a more rapid control than hunting for resistant varieties of plants.
3. The rice by-product might offer wide-scale treatment of plants against viral diseases.
4. It might also be effective against virus diseases of humans and animals.

Sea Blows Bubbles

➤ THE BUBBLES in ocean water that cause a foamy surface are sometimes formed in deep layers, a Navy scientist told biologists at their annual meeting.

Qualitative studies of bubbles, he noted, can be made while "washing dishes, taking a bath, or even sipping a drink at the bar." However, because bubbles are of interest to both marine biologists and underwater sound specialists, Dr. E. C. LaFond of the U. S. Naval Electronics Laboratory, Point Loma, Calif., went to the ocean itself for his study.

Some are formed, he found, from sea floor gas seepage, fish "burps," decomposition of organic matter. Others result from breaking waves, but these do not extend below 20 feet. Some bubbles are formed under sea surface slicks. Others are produced by the generation of oxygen by photosynthetic processes of plankton, and these bubbles are then displaced to the surface by internal waves.

Cell Study Tells Sex

➤ THE SEX of human embryos can now be determined as early as the third week by sex chromatin studies, Dr. Emil Witschi, State University of Iowa, Iowa City, reported to the biologists' meeting.

This shortens the time needed to identify human sex by about four weeks, he explained.

"Questions about the age at which human embryos differentiate into males and females have been much debated during the past 100 years, but specialists generally admitted that sex was not recognizable before the seventh week of embryonic growth, even under the microscope," Dr. Witschi reported.

A developing embryo can also switch its sex from male to female or vice versa. These reversals occur occasionally in humans and come from such conditions as overripeness of the egg at fertilization.

The sex chromatin technique used was developed by Dr. Murray Barr, a Canadian neurologist who found that the nuclei of cells taken from an embryonic heart differed according to the sex of the embryo.

Dr. Witschi tried the same method on a number of preserved human embryos, all less than one inch in length, and found that the developing sex could be recognized well before the differentiation of the sex glands.

Two years ago Dr. Witschi and an associate, Dr. C. Y. Chang, reported that they could experimentally reverse the sex in the African toad Xenopus. Male embryos of the toad had been changed into egg-laying females by giving them estradiol, a female hormone.

Need Biotin in Pregnancy

➤ THE VITAMIN biotin is a must in the diet of pregnant mothers. A biotin-deficient diet can result not only in a termination of the pregnancy, but in the production of smaller and lighter babies suffering from heart abnormalities, damaged livers and underdeveloped kidneys.

This has been shown in experiments with white rats, Drs. William A. Cooper of West Texas State College and Sidney O. Brown of Texas A. and M. College reported to the biologists.

Female rats were made deficient in biotin, normally supplied in the human diet by egg yolk, tomatoes, yeast, cane molasses and other foods, by feeding them a purified diet containing raw egg white. A substance in egg white combines with the vitamin and prevents it from being absorbed from the intestine.

Mother rats fed the experimental diet for five to seven weeks before mating produced offspring that were smaller in size and lighter in weight than those produced by normal mothers. Those rats on the diet for from 12 to 20 weeks before mating produced no offspring.

The smaller newborn rats that were produced had certain heart abnormalities, damaged livers and kidneys that failed to develop properly and "apparently would not function satisfactorily," the scientists said.

Biotin, Drs. Cooper and Brown concluded, must now be added to the lists of vitamins, such as A, K, E, B-2, folic acid, B-6 and B-12, recognized as "factors essential for the maintenance of pregnancy and the production of normal offspring."

Bone Cancer From Tests

➤ SOME HUMAN beings may be presently in danger of developing bone cancer and possibly leukemia as a direct result of nuclear weapons testing.

This was hinted at during a press conference attended by five of the nation's foremost authorities on radiation effects and fallout problems at the biological sciences meeting.

A recent study has shown that the unleashing of 20 more megatons of fallout could tip the scales for some individuals and put them at or over the "maximum permissible for the human body concentration" of cancer-causing strontium-90, Dr. Curtis Newcombe of the U. S. Radiological Defense Laboratory, San Francisco, said.

But 20 more megatons may already have been unleashed.

Dr. Newcombe explained the study was based on the amount of fissionable material from U. S. weapons testing alone. What Russia and England have added to the fallout statistics is not known. The U. S. figures, it is estimated, show 50 megatons of fallout have rained down on earth and carried with them the cancer-causing radioactive element, strontium-90.

This element finds its way into the human body in the water we drink and the food we eat. Just how much depends on the amount of calcium present also. The more calcium, Dr. Newcombe explained, the less strontium-90.

Dr. H. Bentley Glass of Johns Hopkins University, Baltimore, Md., said it is the scientific consensus that if ten megatons of fallout were dumped on the world annually, the safe limit for strontium-90 would still be preserved.

Whether leukemia can be caused by strontium-90 is anybody's guess, the scientists said, but there is always the possibility that it could.

Other scientists participating in the conference were Drs. George W. Beadle of California Institute of Technology and chairman of the National Academy of Sciences' committee on genetic effects, Arnold H. Sparrow of Brookhaven National Laboratory and Carl Swanson of Johns Hopkins University.

Science News Letter, September 7, 1957

HORTICULTURE

Smog Reduces Growth Of Citrus Trees and Fruit

➤ SMOG HAS been pin-pointed as causing substantial weight losses in grapefruit and lemon seedlings, reports Dr. O. Clifton Taylor, horticulturist at the University of California, Riverside.

The effects of both artificial and natural smog were studied.

The dry weight of grapefruit seedlings exposed to artificial smog was reduced 17%. Fresh weight was down 12%. Lemon seedlings suffered greater losses: dry weight was cut 37% and fresh weight dropped 33%.

Natural smog affected trees growing at the Los Angeles State and County Arboretum, Arcadia, to the extent of reducing their growth by 20%, Dr. Taylor has reported.

No visible symptoms of leaf injury were apparent, he said. However, in melon seedlings, exposed to synthetic smog, there was seven times as much leaf drop as in plants of the same type and age grown in purified air. Smog may thus be a possible explanation for leaf drop becoming such a serious problem in the Los Angeles basin over the past four years.

The grapefruit and lemon seedlings were grown in an artificial smog made by reacting ozone with hexene vapor. The smog was kept "closely comparable" to Los Angeles' average daily smog, with an index of about 0.2 parts per million.

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