BIOCHEMISTRY

Photosynthesis—Solution?

How green plants convert sunlight into food is a matter of positives and negatives in final steps, Nobelist Calvin reports to conference near Paris.

➤ THE MOST significant energy mystery in the world seems to be only a step away from solution—how the green plant captures and stores the sun's energy.

A quiet colloquium just concluded at the French National Photosynthesis Laboratory at Gif-sur-Yvette near Paris attracted about two dozen world experts, among them Dr. Melvin Calvin, Nobel Prize-winning chemist of the University of California, who won the honor because of photosynthesis research. He reported his latest proposal as to exactly what happens when the green living chlorophyll material converts solar energy from radiation to a usable stable form.

It is a very complex procedure, chemically and biologically.

The primary act of conversion of energy seems to involve the separation of the negative from the positive. The negative consists of electrons, particles of electricity. The positive consists of the charges or "holes" that the electrons leave behind in the molecules from which they come. This handling of atomic entities, so light even in comparison with the atoms themselves, makes it possible to set up energy barriers without too much cost that will keep confined the energy stored by the solar effect.

Dr. Calvin and his colleagues have been performing experiments to determine the way in which the energy conversion occurs. This involves the separation of the oxygen-seeking and the hydrogen-seeking compounds that result from the impact absorption of the sunlight by the green material. Dr. Calvin has concluded from this that the migration of the holes, or positives, and the migration of the electrons, or negatives, both play a role in the final act of photosynthesis.

Spinach and red bacterium, *Rhodospirillum rubrum*, were the experimental material used. When these photosynthetic materials were placed in an instrument called the electron paramagnetic resonance spectrometer and illuminated, it was possible to see signals showing what was happening to the electrons.

Once the details of the photosynthetic process are ferreted out in this laborious method, there may be enough information to attempt the materializatlon of the dream of duplicating outside living material the unique feat of chlorophyll.

One of the wonders of photosynthesis, as explained by Dr. Calvin, is the handling of a "quantum" or package of energy of many thousands of calories in living systems. This causes chemical transformations at room temperatures at a relatively high efficiency. The energy packets involved are of the order of 38,000 calories for green plants and 30,000 for bacteria, and these are small calories and not the large calories a thousand times greater that are used for food measurement. That means the energy packets are about the energy in two teaspoonsful of sugar.

Dr. Calvin observes that the apparatus which accomplishes this is of labile organic construction and that the thermal reactions which can be performed by such a system rarely, if ever, involve energy changes higher than 10,000 or 15,000 calories. It is an impressive accomplishment indeed, he says, to be able to manipulate a package of energy two or three times that size without damage to the apparatus and in a highly directed and specific way.

The ultimate products of this energy transformation have long been known to us in the form primarily of carbohydrate and oxygen, but, of course, including all of the plant substances, Dr. Calvin said in his paper. Some more immediate products of this energy conversion process in terms of more transient specific energy-storing materials can be described. Two such energy-storing intermediates which can be used to produce the final, or more long term, storage materials are believed to be reduced pyridine nucleotide and adenosine triphosphate. It may turn out that other transient energy-bearing chemical intermediates might be still closer to the energy transformation step itself.

The energy is captured and transferred in a sort of bundle of energy scientists call a quantum. The earlier discovery of a chemical, cytochrome f, in green tissues of plants, suggested that this chemical plays a role in which it was first reduced with production of a strong oxidation and then oxidized with production of a strong reducing agent.

Joining with Dr. Calvin in his paper was Dr. G. M. Androes, while discussions with Drs. Kenneth Sauer, I. D. Kuntz Jr. and F. A. Loach were incorporated in the report.

• Science News Letter, 82:82 August 11, 1962

AGRICULTURE

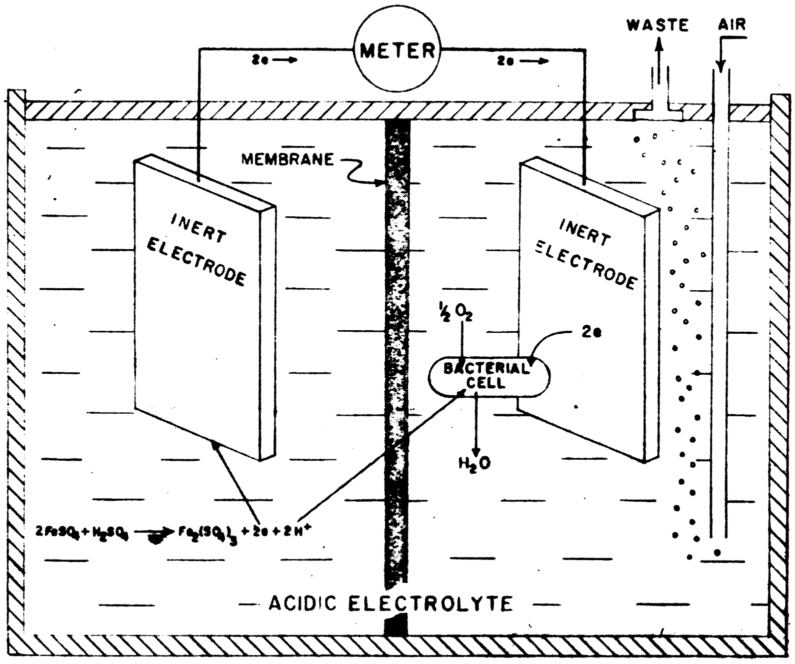
Glass Fiber Mats Protect Waterways

➤ GLASS FIBER MAT was the most effective of seven materials evaluated in Oklahoma tests for ability to protect newly seeded grass waterways.

The materials were rated by W. O. Ree, U. S. Department of Agriculture, Agricultural Research Service hydraulic engineer, according to the velocity of water they withstood without damage to the waterway or the material. The studies were at the Stillwater Hydraulic Laboratory, with the Oklahoma Agricultural Experiment Station cooperating. Temporary protection of new waterways is needed until the grass is established.

Mr. Ree found that a glass fiber channel lining withstood more than four times as much water discharge as the next best material.

• Science News Letter, 82:82 August 11, 1962



BIO-ELECTRIC CELL—This new type cell proves that bacteria use electrons instead of eating solid food. Ferrous sulfate reacts with sulfuric acid giving up two electrons in the left compartment. Bacteria in the right compartment "call" the electrons which pass into the inert electrode, through a wire (top), are registered on a meter and taken off the right inert electrode. ➔