CHEMISTRY-PHYSIOLOGY

Probe Into Origins of Life

Three foreign Nobelists here are investigating muscles, transformation of sunlight into chemical energy by green plants, and the relation of food to glands.

By JANE STAFFORD

➤ THE origins of life are now being probed in researches which combine atomic science and muscle chemistry. The researches, with implications as life-saving as the atomic bomb is life-destroying, are being conducted at the U. S. Public Health Service's National Institutes of Health in Bethesda, Md., on the outskirts of the nation's capital.

Sparking them is Dr. Albert Szent-Gyorgyi of Budapest, Hungary, 1937 winner of the Nobel Prize in medicine for his discoveries resulting in the isolation and identification of vitamin C. Dr. Szent-Gyorgyi is one of three Nobel laureates now working at the National Institutes as special research fellows. The other two are Prof. Otto H. Warburg of Germany and Dr. Bernardo A. Houssay of Argentina.

Dr. Szent-Gyorgyi has a number of young scientists working under him at the National Institutes and at the newly created Muscle Institute at Woods Hole, Mass. Part of his work is carried on in consultation with the National Institutes' own biophysicist Dr. Ralph W. G. Wyckoff.

"We are approaching very fast an understanding of the basic principles of life," Dr. Szent-Gyorgyi told me in an exclusive interview at his home in Bethesda, Md., where he was recuperating from a bout with virus pneumonia.

Muscle is the material he and his associates are studying because, he said, "it is the most wonderful material to study life." It combines mechanical and visible action with chemical and energy changes which are so fast and big that they are "almost explosive."

Muscle has another attraction for scientists probing the origin of life. Most human suffering comes from wrong function of muscle, Dr. Szent-Gyorgyi pointed out in this connection. The immediate cause of death in every second man is failure of muscle.

When you speak of muscle, most people think first of the biceps in the arm, or of leg muscles used in walking. The heart muscle and the muscles in the walls of blood vessels, however, are the ones responsible for so much human suffering and death.

"Our first step into life begins with the work of muscle, the uterus, and life ends with the failure of the heart muscle," Dr. Szent-Gyorgyi pointed out.

"We cannot, however, expect to do something about the failure and disordered action of muscles until we know what muscle is," he continued.

"In the last analysis," Dr. Szent-Gyorgyi said, "life is a play of electrons in atomic shells."

Electrons are present not only in the atomic bomb but in the molecules of protein in muscle and other living tissues. Dr. Szent-Gyorgyi's aim is to unite this knowledge of electron behavior and atomic theory with knowledge of energy exchange in living material, such as muscle.

"When we can do that," he declared, "it will be child's play to tell medical scientists how to put the human machine right when some part of it goes wrong and breaks down."

We humans derive our energy for life from the sun. We get it indirectly, however, through green plants which transform the sun's light into energy to be captured by animals, including man, that eat plants or after conversion by animals into beef, lamb and pork.

How good is the green plant at transforming sunlight into chemical energy? Is it 70% efficient or only 20%? Working at the solution of this problem is another Nobel Prize winner now at the U. S. National Cancer Institute on a special fellowship. This second member of the trio of Nobel laureates at the National Institutes is Prof. Otto Warburg, director of the Kaiser-Wilhelm Institute for Cell Physiology in Berlin-Dahlem, Germany. Collaborating with him are Dr. Dean Burk of the National Cancer Institute and Dr. Sterling B. Hendrichs of the Bureau of Plant Industry, U. S. Department of Agriculture.

Prof. Warburg himself backs the green plant as being 70% efficient. He pays tribute to Nature for a great achievement in having enabled the plant to perform so efficiently. The 70% figure, he points out, is the maximum value that can be reached. The amount of energy transformation, that is, of absorbed light energy, varies with the intensity of the light reaching the plant, with the temperature, and according to whether the plant cells are young, old, or in best condition.

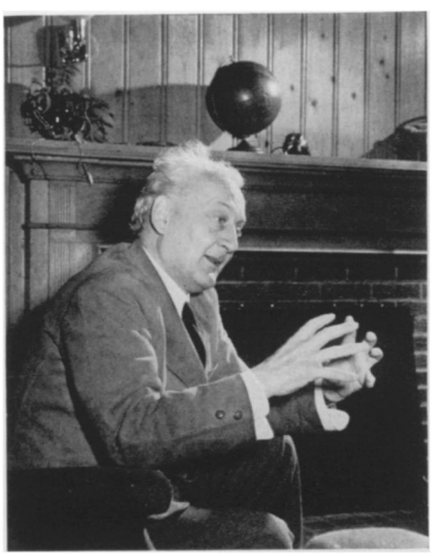
The difference between the 70% figure his researches have given and the 20% figure observed by other scientists is due, Prof. Warburg believes, to methods used in measuring the energy transformation. In the past physical apparatus which would fill a large laboratory has been used in the measurements. Prof. Warburg is now using a small simple piece of apparatus called an actinometer which he devised. It is so simple that a high school science student could use it, and Prof. Warburg hopes it will become useful in simple biological demonstrations.

In the actinometer the amount of oxygen produced by the green plant cells as they convert light into energy is measured by the change in height of a column of fluid. The change is due to the pressure of the oxygen, and the instrument that measures it is really a manometer.

First a measurement is made with two chemicals, ethyl chlorophylide and thiourea. The chlorophylide is a form of the green coloring matter of plants by which they accomplish photosynthesis. With this process, oxygen is liberated. The thiourea picks up the oxygen as it is produced. With his roomful of physical and electrical equipment, Prof. Warburg has determined that in this process, one molecule of oxygen is consumed by the thiourea for every quantum of light shining on the chlorophyl material.

With the reading on the manometer scale as a secondary standard, Prof. Warburg next reads the scale when green plant cells alone are in the actinometer with light shining on them. If, with the same amount of light the first reading is 40, and the second, for the plant cells, is four, it means there is one-fourth the oxygen exchange per quantum of light. Turning this around, one molecule of oxygen is produced by the plant cells for every four quanta of light.

The 70% efficiency of green plants at their best is so great that Prof. Warburg does not see any hope for artificial photosynthesis as a practical means of producing



DR. ALBERT SZENT-GYORGYI ***—This Hungarian scientist hopes to unite atomic science with muscle chemistry for better understanding of life's basic principles.***

RESEARCHERS CONFER—Prof. Otto Warburg of Germany (left) and Dr. Bernardo A. Houssay (center) of Argentina, two of the Nobel laureates, discuss plans with Dr. R. E. Dyer, director of the National Institutes of Health, where they are working as special research fellows.

food synthetically. It would be easy enough, in his opinion, to do in the laboratory what the plant does, that is, to produce carbohydrates from carbon dioxide and water under the influence of light. But it would be too complex and costly a procedure to have practical value.

"We must still have our meadows," he stated.

The food we eat and its relation to the glands in our bodies is being investigated by a third Nobelist now working at the National Institutes of Health under a special research fellowship, Dr. Bernardo A. Houssay of Argentina.

Most familiar example of a relation between food and body glands is the relation between the pancreas, which produces insulin, and sugar and starch utilization. Diabetics are taught that their bodies cannot handle sugars and starches properly because the pancreas fails to produce insulin in normal amounts. The pancreas and insulin, however, are only one part of the situation.

Two other glands, the pituitary buried deep inside the head, and the adrenals, one above each kidney, also play a part in sugar and starch handling by the body. It was in recognition of his discovery of the significance of the pituitary gland in this connection that Dr. Houssay shared in the Nobel Prize award in 1947.

If the action of the pancreas is suppressed, there is not only a lack of insulin, but also a diabetes-producing action on the part of the adrenal glands and the pituitary to contend with. If, on the other hand, the action of the pituitary and adrenal glands is suppressed, the action of insulin becomes more intense. For proper handling of sugars and starches, there must be not only healthy pancreas tissue to produce insulin but a balance between the various glands.

This matter of balance, Dr. Houssay emphasized, is the most important thing in human beings. There must be balance between glands that tend to cause increased sugar in the blood and those that tend to cause decreased sugar in the blood. There must be balance between mechanisms in the body for producing heat and for dissipating it. Many other body processes operate on this balance principle.

The glands of the body regulate many processes, such as growth, constitution, blood circulation nad behavior. But, Dr. Houssay stressed, they do not produce these things. And always there must be balance between the glands or the body does not function properly.

"If we can recover from sickness," he said, "it is because we have the mechanism for balance. Doctors and medicines they prescribe can help, but cannot produce new functions.

"The healing power of nature," he declared, "is essentially a matter of balance and its restoration."

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Sugarcane waste, the so-called bagasse, was once burned in great piles as a useless material; later it was found to be valuable as fuel in sugarcane plants, and is now used also as raw material in manufacturing a wallboard.