PHYSIOLOGY

Every Life Process Governed By Enzymes and Vitamins

Millions of Body's Cells Obtain Their Energy From Chemical Reactions Made Possible by These Substances

By DR T. R. HOGNESS

Professor of Chemistry, University of Chicago.

(At the Universities of Wisconsin and Chicago week-long meetings on enzymes and vitamins have been taking place. This is an expert evaluation of this important branch of science from a talk arranged by Science Service over the Columbia Broadcasting System.)

BECAUSE of the very small quantities of vitamins necessary to maintain growth or to correct deficiencies which impair normal body functions, chemists have for many years suspected that the vitamins are not consumed, as is sugar for instance, in the normal cell functions, but rather that the vitamins in some way act as catalysts or promoters for other energy and growth-producing chemical reactions which take place in the body.

About eight years ago this suspicion was confirmed by direct experimental evidence and since that time many other experiments have been made by biochemists which have corroborated this original finding until today we know just what the chemical action of several of the vitamins is.

Before I tell you something about the chemical action of the vitamins, I should first explain what the chemist means by the word catalyst, or catalysis. To do this I shall use a rather common chemical example: the manufacture of ammonia from hydrogen, obtained from water, and nitrogen, obtained from air. Incidentally this is a very important chemical reaction in these days, for it is from ammonia that nitric acid is made, and nitric acid is used in making practically all explosives. The hydrogen and nitrogen are mixed and compressed and even under high pressure nothing would happen; that is, there would be no chemical reaction, unless there were present in this mixture some very specially made iron. With this iron present, the nitrogen and hydrogen combine with each other and as a result ammonia is formed. In this case the special iron is the catalyst. It brings about or promotes the reaction. The iron is not used up and a relatively small amount of it can bring about the conversion of a large amount of nitrogen and hydrogen to ammonia. The whole promoting process is known as catalysis.

Chemical reactions in the body produce the heat and energy necessary for maintenance of life and growth. The food we eat and the oxygen in the air that we breathe combine with each other and form water and carbon dioxide which is then exhaled from the lungs. This burning process produces energy (or work) and heat just as the burning of coal in the firebox of the locomotive produces work and heat. But this burning process in the body—or more exactly in the cells of the body—can not take place unless catalysts are present.

Sugar left by itself cannot burn or be consumed by air at ordinary room temperature or even at the temperature of the body. Every man, if he stops to consider, knows that this is so. Sugar, or a solution of sugar, can be left in an open dish exposed to air and the sugar does not disappear. But if the sugar is eaten it is converted into carbon dioxide and water in a relatively short time. The difference lies in the presence of catalysts in the cells of the body. The catalysts are therefore very important.

This is where the vitamins come into play. They are the catalysts; rather, they are used by the body to make the catalysts necessary to bring about the chemical reactions which actuate and regulate the life processes. We might even go so far as to make a reasonable guess that the agency governing every life process is a catalytically controlled chemical reaction.

The catalysts which bring about the chemical reactions occurring in the body or the cell—these processes also take place in bacteria and other small organisms—have been given a special name. They are known as enzymes.

The human body is composed of millions of cells and each of these cells has a certain function to perform. It has a job to do, but to do this job it must have energy which it derives from chemical reactions involved in the burning of food. To bring about the chemical reactions in the right place the cells contain the different enzymes or catalysts necessary to produce the chemical reactions, which, in turn, carry out the job assigned to the cell. If the enzymes are lacking, the chemical reactions will not take place and the job will not be done. The result may be some disease such as pellagra or beri-beri.

Some place in the body the necessary enzymes are produced—perhaps in the cell which is going to need them—but to do so certain starting materials are necessary. These starting materials necessary to make the catalysts are the vitamins. The body modifies these vitamins, more or less as the case may be, hitching other substances present in the body to them, and as a result enzymes are formed.

The process of burning a sugar molecule in the body is a complicated one, involving many steps. Each step involves a different enzyme or catalyst. The chemist is trying to learn specifically what each of these steps consists of and which enzyme is involved in which step. We now have a considerable knowledge in this field, a resume of which was just given at the symposium at the University of Chicago and the University of Wisconsin.

We know, for example, that when a human being is suffering from pellagra, which specific steps in the oxidation process are not operating. They do not operate because they lack the necessary enzymes and the body cannot produce these enzymes unless the patient is given nicotinic acid. Although we know a great deal, there is yet very much more to be learned in this field. Much scientific endeavor is therefore turned in this direction and in the next few years considerably more will be known about these fundamental life processes.

Science News Letter, September 27, 1941

PUBLIC HEALTH

Tuberculosis Increasing In War Torn Europe

TUBERCULOSIS is now taking an increasing toll in war torn Europe, and in less advanced countries the death rate is likely to mount to frightful proportions as in 1914-1918. So statisticians in the United States are convinced.

"Despite absence of statistics, it is certain that tuberculosis is on the rise in all the areas that have been overrun," says a report by Metropolitan Life Insurance Company statisticians.

Clues are revealed in reports from lands outside the Nazi grip. Vichy reports a sharp increase in tuberculosis. In England and Wales the tuberculosis death rate for male civilians has risen 13%. For females the increase was 7%.

The longer the war, and the farther it extends, the greater will be the tuberculosis toll, particularly on the Continent, the statisticians predict. In World War One, every belligerent country had an increase in this disease, and practically all neutral countries of Europe had an actual increase or were set back in their fight to control tuberculosis. In England, pulmonary tuberculosis deaths were 25% higher in 1918 than in 1913. Among German women the rate was nearly 75% higher.

While Germany today is in the most favorable position of the Continental areas, the statisticians say it is unlikely that Germany has escaped an increased tuberculosis toll in this war.

Science News Letter, September 27, 1941

Russian officials compare *Moscow* with Chicago, saying that it has about the same population and is an all-around industrial center.

Lignin, a substance in woody tissue, is reported to be a good source of vanillin for flavoring agents.

New Machines And Gadgets

Novel Things for Better Living

Where's that safety pin? will no longer be heard in baby's room if a pinless diaper recently patented is used. Nor will the baby's shriek be heard as careless Papa essays to "change the baby." The new diaper is of a special shape, with a ribbon attached at one end and four slots on the opposite side. The diaper is folded on in the usual way, the ribbon is passed through the slots, and a pretty bow is tied. Thus the garment is ornamental as well as useful, and baby will doubtless be proud of his very modern attire.

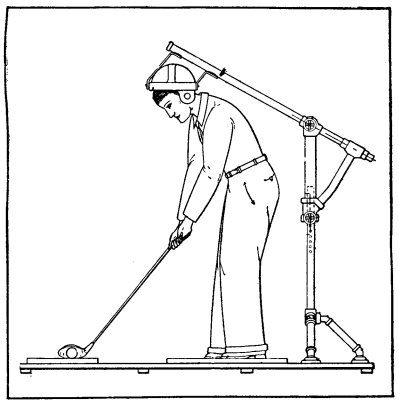
Burnt-out bearings will be a less frequent source of trouble and delay if use is made of one of a new line of "dry" oils now on the market. The oils are black and forbidding in color because they contain graphite in a finely divided state. When the oil dries out it leaves a thin film of dry graphite on the bearing surfaces. This prevents metal-to-metal contact and thus saves burning or abrasion in case of a delay in providing a new supply of oil.

An awning made like a Venetian blind has recently been patented. In place of slats it uses miniature awnings, one above the other, which therefore hang close to the window. It can be pulled part way or all of the way down, to cover any desired portion or the whole of the window—something that cannot be done with the ordinary awning.

A robot trailer brake, completely automatic in its operation, has recently been patented. When the towing car slows down, or holds back on a down grade, the trailer brake, all by itself, without human aid, sets itself so as to prevent the trailer from bumping into the car or pushing it. As soon as the trailer has been slowed down to the speed of the car, the brake releases itself. Thus the driver is relieved of all worry about the trailer. The mechanism can also be locked out of operation when the car is backing or maneuvering.

Old automobile bodies are now compressed by a huge press into a tight bale in a few seconds, and truckloads and carloads of these bales are shipped daily to the steel mills. Formerly old automobile bodies have lain rusting on out-of-town lots because there was no quick way of handling them.

Head down, eye on the ball, will not be easily forgotten by golfers if they use a recently patented "golfer's training rack." A sort of helmet, which is



attached to supporting arms that are adjustable according to the golfer's height, holds the head still and in the proper position while the golfer executes his swing. The whole apparatus is supported by a platform on which the golfer stands. With head and feet fixedly in place, the inventor claims that the body is forced to execute the proper pivotal motion, and that practice with this device will obviate the services of a more expensive human instructor.

Balloon fabrics and other fabrics that must be as nearly gastight as possible can now be tested for leakage by means of a new "fabric permeameter." The test requires only a few minutes and the meter reads directly in "liters per square meter per 24 hours." A liter is a trifle more than a quart, and a square meter is a little larger than a square yard. Tests of the effectiveness of the various dopes with which the fabrics are treated, as well as leakage at the seams can be made. In addition to many other applications connected with National Defense, the instrument can be used to test materials for packaging tobacco products, foods, and other substances in which aroma is important.

If you want more information on the new things described here, send a three-cent stamp to Science News Letter, 1719 N St. N. W., Washington, D. C., and ask for Gadget Bulletin 72.

Science News Letter, September 27, 1941