biological sciences

From our reporter at the meeting of the Federation of American Societies for Experimental Biology in Atlantic City

The chemistry of sleep

A number of investigators are intrigued by the mechanism of sleep. They are trying, for example, to find out at what stages of sleep dreams occur most, and whether dream content is influenced by sensory inputs during sleep. Some researchers are trying to define sleep in biochemical terms. J. Michael Anchors and his team of biological chemists at Harvard Medical School have found proteins containing phosphorous are used heavily during sleep.

They observed several years ago that a phosphoprotein showed increased use in the brain of sleeping baby rats. So they decided to look for phosphoprotein activity in the brains of sleeping adult rats. They injected radioactive phosphate into the brains of sleeping rats and into the brains of rats that were awake. They extracted the brains of both groups of animals and examined them for the presence of phosphoproteins. They found a lot more phosphoproteins in the brains of the sleeping animals than in the brains of the control group.

They are now trying to determine the exact chemistry of the phosphoproteins. They will then try to define the enzymes that lead to their heavy use during sleep periods. They suspect that phosphoprotein use may be conditioned by the hormonal state of sleep.

Cancer cells and weird proteins

One of the dogmas of modern biology is that all cells in the same organism contain the same genetic material, yet become differentiated, or assume specialized functions, largely as a result of gene regulation. In other words, gene regulators allow the expression of certain proteins (enzymes) in some cells, but not in others. Many cancer scientists believe that cancer occurs when specialized cells revert to an undifferentiated state in which proteins usually made no longer are made, and proteins that usually are not manufactured are manufactured. Evidence mounts to support this theory.

Several proteins usually found in fetal cells have been identified in adult human cancer cells. Several protein hormones that usually do not appear in certain tissues are expressed in those tissues if they are cancerous. Several abnormally structured enzymes that metabolize amino acids have been found in human cancer cells.

Sidney Weinhouse of the Temple University School of Medicine now reports that he has identified six abnormal sugar-metabolizing enzymes in cancerous liver cells in humans. Says Weinhouse: "What this means as far as cancer is concerned we do not know, but it points to an error in differentiation. That is, in cancer cells, gene-control over protein expression is lost."

Switching off a gene operon

During the past decade or so, biologists have learned that genes are regulated by intricate feedback mechanisms. They have learned for example, that if galactose (a sugar) is given to a bacterium, the galactose releases a protein repressor. This protein usually sits on an operon (a unit of several regulatory genes). The operon regulates the gene that makes a galactose enzyme. Thus, if the protein repressor gets off the operon, the operon is free to tell the galactose gene to make a galactose enzyme. The newly made galactose enzyme then metabolizes (breaks down) the galactose that entered the bacterium.

Little has been known, however, about how operons are switched off. Now Max Gottesman of the National Cancer Institute and his colleagues have some evidence for this mechanism. They have found that a protein called "rho" terminates galactose enzyme production by sitting on the galactose operon. They have also found that if a certain virus attacks the bacterium, it attacks the rho protein in the bacterium. Rho is then incapacitated; the operon is free and the galactose gene can go on making a galactose enzyme indefinitely. The virus, in other words, messes up normal biochemical activity in the bacterium by preventing operon termination. Cancer viruses, Gottesman speculates, may interfere with operon termination in human cells.

Alcoholism and a frisky pineal gland

Alcoholism may be related to the pineal gland in the brain, according to new evidence by Kenneth Blum, a pharmacologist at the University of Texas Medical School.

Since the pineal is believed to be the only organ besides the eyes that describe external light conditions to the body, Blum and his colleagues decided to use light and dark to test the pineal's influence on alcohol consumption. First they exposed rats to equal periods of light and dark. The rats drank more water than alcohol. Then half the rats had their pineals removed. Now all the animals were put in near-total darkness, with a choice of alcohol and water. The rats with pineals drank much more alcohol than water; rats without pineals drank much more water than alcohol. When the animals were returned to equal periods of light and dark, the rats with pineals retained their liking for alcohol. Apparently they had become alcoholics.

How might the results apply to humans? Says Blum: "We know that pineal activity varies greatly in humans. It is possible that alcoholics may have highly active pineals. A test, based on substances produced by the pineal, would have to be devised to determine this. Such a test could be part of any routine blood test and could be valuable in pinpointing a tendency to alcoholism before the condition develops. Then, presumably, if inhibitors are found, they could be administered."

Dangers of a high-protein diet?

A number of people have found they can lose weight with minimum discomfort and fatigue by going on a high-protein low-carbohydrate diet. However, such an inbalanced diet may hurt the body if continued for any length of time. Harold Yacowitz and his colleagues at Fairleigh Dickinson University have found that a high-protein diet breaks down some protein tissues and triggers a loss of calcium from bone.

They studied five overweight but otherwise healthy male and female volunteers. All five were allowed free choice of their regular diet for two weeks. Then they were put on a high-protein diet for several weeks. All took a vitamin-mineral capsule during the control and test periods. All lost five to nine pounds during the test period. The researchers noted that when the subjects were on the high-protein, low-carbohydrate diet, there was a significant increase in their blood of an enzyme, which suggests protein tissue was being broken down in their bodies. The subjects also excreted a lot of calcium in their urine. This suggests their bones were being depleted of this essential mineral.