SCIENCE NEWS

Science Service, Washington, D. C.

THE PRESIDENTIAL ADDRESS AT THE MEETING OF THE AMERICAN ASSOCIATION OF ANATOMISTS IN TORONTO

DR. FREDERIC T. LEWIS, James Stillman professor of comparative anatomy at the Harvard Medical School, gave the presidential address before the meeting of the American Association of Anatomists recently held at Toronto. Part of Dr. Lewis's address is given here.

The bodies of animals and plants are built of cells which are primarily liquid drops. We begin our existence —turning a deaf ear to Aristotelian and scholastic dialectic—as a spherical drop of liquid. We arise as a cell which has the form of a soap bubble or rain drop. The wonderful globular form of a drop of rain is due to an enveloping skin, which has the properties of a stretched elastic membrane. Robert Boyle, in 1676, warily let fall some drops of oil into rectified spirit supernatant to a solution of niter, thinking to explain the structure of the universe. It was the beginning of physical and chemical studies of the tension which abides in the external layer of the drop, whereby the drop constantly strives to contract and occupy the least possible space. It makes a handsome sphere of the egg yolk or the smaller rabbit's ovum, both of which are single initial cells.

The first drop then divides into a pair, Siamese twinned, joined to one another by a membrane of the same tension as that which covers their exterior. More divisions follow, resulting in a cluster of liquid drops, arranged in accordance with laws established by the Belgian physicist, Plateau, in his masterly study of soap suds (Statique des liquides, 1873). Three films, belonging to three bubbles, meet along every edge: six films, belonging to four bubbles meet at every corner. Hence, as shown by Lord Kelvin, an entire bubble, surrounded by other bubbles of the same size and filling space without interstices, will have 14 facets of contact with its neighbors. If the tension of its walls keeps its surface minimal, it will have eight hexagonal facets and six square facets. Cells of elder pith show a recognizable approach to this ideal pattern. Other cells of plants and animals, more irregular in size and arrangement, likewise present the average of 14 facets, though diverse in outline. There are many pentagonal faces. This outcome is a mathematical necessity for liquid drops in masses when obedient to Plateau's laws.

When tension causes three facets to meet at every corner of the faceted drop (and any other arrangement is unstable) then the total number of sides of the polygons covering a cell will be twelve less than if they were all hexagons. In a cube, three faces meet at every corner; the six squares which bound the cube have twelve sides less than six hexagons. This will apply to every cell with 3-rayed vertices, as, for example, to the 14-hedron with its eight hexagonal and six square faces. It is a corollary of Euler's famous theorem for all polyhedra, invented by the eminent Swiss mathematician in 1752.

Under these conditions the cellular mosaic, forming, for example, the epidermis of a cucumber, or lining the human intestine, will approach the hexangular pattern of honeycomb. As the cells grow and divide, pentagonal and heptagonal elements are introduced, but the average of six sides is maintained along the tube. Whenever an element is pushed out, regardless of its number of sides, and the gap is closed with none but 3-rayed vertices, the mosaic loses just six sides. When, by division, a new cell is added, having any number of sides but making 3-rayed vertices only, the mosaic will gain six sides. Under these stringent mathematical requirements, cells present an array of beautiful patterns, complicated by the development of spaces at the corners and edges, where the tension that makes cells round prompts them to separate most readily. For all these patterns there is a simple hydrostatic basis. Cells are fundamentally liquid drops—gland lobules and vascular units are larger drops—all subject to Plateau's laws and to the corollary of Euler's theorem for polyhedra. Thus neatly, in making cells and glands, "nature geometrizeth and observeth order."

THE STRUCTURE OF THE ANTIBODY

DR. SANFORD B. HOOKER, professor of immunology at Boston University, in giving the presidential address before the American Association of Immunologists, meeting in Chicago on March 24, reviewed current researches on the antibody.

It is considered to be a kind of protein molecule formed by certain body cells when influenced by an antigen such as the toxin of the diphtheria bacillus. This protein molecule, called antibody globulin, is different from other globulin molecules. It has, probably at the surface of each molecule, specific combining groups. The antigen molecule, formed by the bacteria, also has combining groups at its surface. The union of these two is important in producing immunity. Antigen molecules have many combining groups, not necessarily of the same kind. Antibody molecules, formed by the body's cells, have each only one or a relatively few combining groups. The combining groups are thought of as more or less complex patterns of binding points. Those on the antibody molecule are distributed in a pattern that is the mirror image of the binding point pattern of the antigen. The antibody binding points have electrical charges which are the opposite of those carried by the antigen binding points.

One kind of combining group, it is assumed, must contain at least 3 properly adapted points which differ from those of another kind of combining group in atomic nature, spacing and sign and strength of electric charge. A single kind of antigen combining group, if sufficiently complex, may call forth somewhat different kinds of antibody. The perfect "master-key" antibody molecules would be those which most faithfully and completely reflect the physical characters which determine the specificity of the antigen. Such antibody molecules would have

binding points which could unite effectively with the antigen binding points and neutralize the antigen.

The same antiserum may contain grades of more imperfect and dissociable antibodies extending to the poorest kind whose pattern is so incomplete as to have the least affinity permissive of any recognizable association with antigen. The more of these high-grade antibodies in an antiserum, the more effective will be the serum in protecting against disease.

THE ROLE OF SEX HORMONES IN CANCER

PAIRS of male and female mice, joined Siamese-twin fashion by surgical operation so that they had a common blood supply, have helped to identify the sex hormone that might play a part in breast cancer causation. The studies were reported by Dr. William S. Murray, of the New York State Institute for the Study of Malignant Disease, Buffalo, at the recent Chicago meeting of the American Association for Cancer Research.

One of the female sex hormones, the luteal fraction of the ovarian hormone, is the hormone that may lead to the formation of breast cancer in mice. It has previously been found that the ovarian hormones, acting upon or accumulating in the breast tissues of mice, upset the balance between the various hormones in the body, and instigate the formation of cancers. Whether it was the amount or the kind of sex hormone that led to cancer formation was the question Dr. Murray set himself to solve with the paired male and female mice. Male mice of the strain he studied never developed breast cancer. In breeding females of the strain, breast cancer appeared in from 65 per cent. to 100 per cent. under the stimulation of the hormones of oestrus, pregnancy and lactation, whereas in virgin females the ovarian hormones producing oestrus alone caused breast cancer in only 50 per cent. of the mice.

By pairing the male and female mice so that they had a common blood supply, both came under the influence of the same amount and kind of sex hormones, both male and female. Introduction of the male hormones into the blood stream of the females upset the sexual cycle in the females. The ovaries were stimulated to precocious development of follicles which degenerated so that no luteal tissue or hormone was formed. Neither males nor females developed breast tumors. Since the luteal fraction of the ovarian hormone was absent, Dr. Murray concludes that this is the hormone that plays a rôle in the development of breast cancer in mice.

INDUSTRIAL CANCER

DUSTY air, such as miners, stone cutters and many others work in all day long, is a health hazard and may cause diseases like silicosis, but it is probably not a cause of lung cancer in this country. This is the conclusion of a study reported by Drs. Arthur J. Vorwald and John Karr, of Saranac Laboratory, Saranac Lake, N. Y., at the meeting in Chicago of the American Association of Pathologists and Bacteriologists.

The tendency to regard inhaled dust as a cause of lung cancer was prompted by reports from mining districts in Europe. The number of cases of cancer among miners there is unusually high. The ore dust in these mines is radioactive and therefore induces changes in the lungs which eventually develop into cancer. These observations do not justify the conclusion that all dusts cause cancer. The great majority of dusts are not radioactive and do not, so far as known, contain cancer-producing substances. If they did, the amount of lung cancer in men and experimental animals exposed to occupational dusts for long periods of time should be unusually high. A survey of patients suffering from pneumonokoniosis, the lung condition that is due to breathing dusty air, and observations on patients and animals at the Saranac Laboratory do not support this view.

Cancer and tumors of the bladder can be caused by prolonged exposure to aniline dyes. Experimental proof for this long-suspected relation between the tumors and exposure to the dyes was obtained in studies reported by Drs. W. C. Hueper and H. D. Wolfe, of Wilmington.

FEVER TREATMENT

FEVER treatment does not cure disease by killing disease germs. In diseases like syphilis and gonorrhea, fever should be used with chemical treatment as a means of building up resistance of organs and other body tissues against the germs of the diseases so that "the infection must eventually die away by itself." Professor Julius Wagner-Jauregg, Nobel laureate, who originated fever treatment for the mental disease that is the late stage of syphilis, gave this explanation of how fever helps cure disease in a message to the First International Conference on Fever Therapy. The conference, of which he is honorary chairman, opened in New York on March 29.

Contradicting those who believe that the high artificial fever cures by killing the disease germs, Professor Wagner-Jauregg pointed out that the spirochetes of syphilis are present in the human organism for different periods of time. They are still capable of living even after a successful treatment with artificial fever, whether induced by malaria or by physical means such as short-waves or fever chambers. The same holds true for the organisms of gonorrhea. The patient, however, is well after successful treatment.

Professor Wagner-Jauregg first tried malarial fever as a cure for general paralysis of the insane, late stage of syphilis, in 1917. His success with this kind of fever treatment, in which the fever was produced by deliberately giving the syphilitic patient malaria, started a world-wide wave of fever treatment. Long before 1917, however, Professor Wagner-Jauregg had tried to cure mental diseases by artificial fever. In 1891 he made his first attempts, using tuberculin. Some of these early patients recovered and "enjoy the best health even now, after more than 20 years," according to Professor Wagner-Jauregg. Even before that, as early as 1897, he held that the high fever does not kill the germs, but is an index of the intensity of the curative process running its course.

THE MEASUREMENT OF PROJECTILE SPEED

AN artillery shell crashing through invisible curtains of light is the newest means of determining the speed of

projectiles developed at the National Research Laboratories of Canada in Ottawa. Particular merit of the system is its portability which enables it to be used in the field and bring added accuracy to computations of range in actual combat. Light beams, mirrors, photoelectric cells and sensitive recording mechanism are the equipment which makes possible the new development of Dr. D. C. Rose, physicist in the division of physics and electrical engineering of the National Research Laboratories.

In effect the artillery shell passes down a narrow tunnel and every 50 feet intersects a beam of light falling on a photocell. Momentarily the shell blocks off the light beam and this decrease in light intensity cuts down the electrical output of the cell. By an amplifying system this electrical change produces a permanent record on photographic film.

In field tests at the military camp at Petawawa, Dr. Rose set up metal frames whose upper and lower surfaces consisted of mirrors. A beam of light started from the bottom and was reflected back and forth across the space between the mirrors until its ray finally fell on a photoelectric cell concealed in a small box attached to the upper part of the frame. Thus the entire space within the frame was filled with a light beam which could be blocked out by the onrushing shell.

A series of four of these frames were carefully lined up before an artillery piece which at a known, and automatically registered, instant fired its shell through the frames. Initial firing was merely through paper screens to test the alignment of the gun for its "jump" characteristics and to demonstrate that the automatic firing mechanism was working accurately. In subsequent tests the light beams and photocell frames were employed.

The timing of the speeding shells—which were found to be moving with a velocity of 1,585 to 1,600 feet a second—was accomplished by having the weakened photocell current swing a sensitive galvanometer. A beam of light striking a small mirror on this instrument was then reflected back to a moving motion picture film. Simultaneously tiny markings created by a constant pitch tuning fork gave time signals on the film. Some 497.7 of these marks represented one second in actual time.

GRASSHOPPERS IN THE WEST

GRASSHOPPERS, to rival the locust plague of Egypt, menace the crops and rangelands of the United States. Unless spring brings persistent, cold rains when the young insects emerge from the eggs now in the ground, 1937 will go down in history as the worst grasshopper year since the sky-darkened days of the Kansas pioneers.

This warning from the U. S. Department of Agriculture is based on a careful survey of the overwintering eggs now in the ground. Never in this century have there been so many—and the winter weather has done them practically no harm. They are ready to hatch as soon as the ground is thoroughly warm.

The area to be affected covers practically all of the prairie and plains regions, and extends into the intermountain areas of Utah and Arizona. Heavy infestations are reported from the foothills of the Rockies in Montana, Wyoming and Colorado, eastward to central Illinois. The situation in western, central and southern Iowa is reported as especially menacing. There is an isolated region of severe infestation in the northern part of Michigan's lower peninsula.

Federal and state scientists know how to combat the pest, and farmers have learned to serve as shock troops with the poisoned bran bait which government funds have supplied. A bill to provide money for this year's campaign against the insects is now pending in Congress. If the grasshopper plague develops to its full anticipated strength 84,000 tons of poisoned bran will be required for effective control.

Bran bait is made by mixing coarse bran with an arsenic compound, usually sodium arsenite. Molasses was formerly added, but is now usually omitted. It has been found that sawdust can be substituted for part of the bran.

The prepared bait is spread thinly over the areas where the young grasshoppers, their wings still ungrown, are crawling. It is sown by hand, or with a broadcast sowing machine.

ITEMS

A NEW vitamin, designated with the letter "P" by its Hungarian discoverers, is reported in *Industrial and Engineering Chemistry*. Vitamin P appears to be closely related to vitamin C and, like the better known substance, is found in lemons and paprika. Professor A. Szent-Gyorgyi, of Szeged University, Hungary, who discovered ascorbic acid, is credited with the new find. The exact chemical nature of vitamin P is now being studied but already it appears to consist of a very large molecule containing either 81 or 83 atoms of carbon, hydrogen and oxygen. The compound is said to decrease the permeability of cells to albumin and for this reason is supposed to have vitamin-like properties. The new substance appears to be a natural companion of vitamin C in plants.

CHINA'S appalling famine, that is claiming thousands of lives in Honan and Szechuen provinces, is caused by climatic and geographic factors very similar to those operating in western parts of the United States. These provinces of China, like the Great Plains area in our own country, are on the leeward side of great mountain barriers and the far end of a long journey of the prevailing winds. They are therefore regions of low rainfall in normal times, because most of the moisture has been squeezed out of the air masses before they reach this part of Asia. Even a slight decline in a season's precipitation brings the menace of drought. To these conditions must be added a factor that is less important in the United States. Although these interior provinces are not so densely populated as the swarming areas nearer the coast, they are still far more thickly peopled than our own Plains region. Therefore a shortage following severe drought makes itself felt immediately. Furthermore, transportation lines such as in this country rush supplies into a drought-stricken area are almost lacking in China. Without a local food reserve, with no effective means for bringing in outside supplies, drought means immediate disaster.