SCIENCE NEWS

Science Service, Washington, D. C.

THE SECOND LAW OF THERMODYNAMICS

A NEW theory which may explain why the physical world sometimes behaves unexpectedly has been outlined by Professor G. N. Lewis, of the University of California. The new system is called generalized thermodynamics.

The science of thermodynamics, which has been so powerful in explaining large classes of physical phenomena, is inadequate in that it does not include those fluctuations from the condition of balance that actually occur in the world. Professor Lewis, who is well known as one of the most important thinkers on the fundamentals of science, has attempted to bring the known facts about fluctuations and the general laws of thermodynamics into one scheme. Though it is impossible at present to say what value the new theory has, scientists will study with interest this latest contribution to a basic question. Thermodynamics is the science of the broad relations between physical quantities which does not require any special knowledge as to how substances are made up of atoms. It is fundamental in the scientific discussion of engines and motors, for instance.

The second law of thermodynamics, which tells us that the world is becoming more and more mixed up as time goes on, has been given a new formulation by Professor Lewis in his paper. He claims that his is the first really valid statement of the law that will stand examination in the light of the unexpected happenings which sometimes appear. Those unforeseen fluctuations, though regular to a certain degree, are nevertheless at variance with the regularities of thermodynamics.

Thermodynamics tells us that a system of physical bodies isolated from others will steadily change towards a unique condition of balance or equilibrium. In point of fact the final condition is one in which the balance oscillates between states near the true balance. These fluctuations from the theoretical balance are such that ordinary thermodynamics can not inform us of them. Some time ago Professor Albert Einstein combined the first approximation given by thermodynamics with the Boltzman probability theorem and thus obtained a first solution of the problem.

Professor Lewis has now carried the question a step further. He expresses the crucial point of his new discovery as follows: "All the laws of thermodynamics and of fluctuations may be shown to follow from a single cardinal postulate, which is essentially the following: If a given amount of some quantity such as energy or any form of matter is allowed to distribute itself between two systems, so that by one observation we find a certain fraction of the total amount in the first system, and again, after a long time by a second observation we find a slightly different fraction, and so on until the statistical rules governing the observations have been ascertained—then these rules are independent of the mode of communication between the two systems."

THE TUBERCULIN TEST

IOWA farmers who have carried their objection to tuberculin testing of their cattle almost to the point of armed rebellion have permitted themselves to become excited over a misunderstanding, and to a certain extent over deliberately spread misinformation. Such is the opinion expressed by scientists at the U. S. Department of Agriculture at Washington.

Tuberculin never does a healthy cow the slightest harm, declared Dr. M. Dorset, chief of the biochemic division of the Bureau of Animal Industry, in an interview given to a representative of Science Service. It does not even hurt a tuberculous animal, but merely shows that she has the disease and ought to be slaughtered in the interests of community health. Claims to the contrary, he indicated, are the results either of lack of information as to its real nature or of hostile propaganda. Tuberculin is essentially the clear, sterilized fluid derived from broth cultures of the tuberculosis bacillus, he said. It is entirely free of tubercle bacilli and of harmful bacteria of all kinds.

The test is administered in a way that will cause no discomfort to healthy animals and only a minimum to sick ones. A single drop of the fluid is injected into the thin skin on the under side of the tail. After from forty-eight to seventy-two hours this point of injection is examined. If the animal is healthy, no trace of the injection will then be found. If there is a small, inflamed lump, it is judged due to the reaction of the tuberculin upon the animal's tissues which have been made hypersensitive by the presence, somewhere in the body, of tubercular infection.

The fluid used by the testing officers is essentially the same as that used in determining whether or not a human patient has tuberculosis, Dr. Dorset said. In fact, tuberculin was originally made in the hope that it would be a cure for tuberculosis, and when it was found that it could not do that it was also learned that it could be made very useful as a sensitive agent in diagnosis.

The work of tuberculin testing of cattle all over the country is carried on cooperatively by the U. S. Department of Agriculture and the various state governments. Field men representing both the department and the states work together, and both federal and state funds are used in reimbursing farmers for cattle which it is found necessary to have killed. There have been some lawsuits against the official bodies concerned by disbelievers in the efficacy of tuberculin testing, but these have all been decided in favor of the Department of Agriculture and of the states. Hitherto no resistance by force has been offered, and department officers feel sure that the work of testing will be carried on after the present flare-up in the Mid-west has been peacefully settled.

THE STUDY OF IDENTICAL TWINS

WANTED: Identical twins who have been reared apart, for purposes of scientific investigation.

A great service would be rendered to science by any one who could give information about such twins, Professor H. H. Newman, of the University of Chicago, stated in a radio talk presented recently under the auspices of Science Service over the Columbia Broadcasting System. "Identical twins are those twins that look so much alike that they are often mistaken for each other," Professor Newman explained. "When they are babies one sometimes gets two baths and the other none, and when they are grown up even their best friends call one by the name of the other." Such twins have identical heredities, and consequently when reared apart make excellent material for study of the old problem of whether nature or nurture has more effect on the individual.

"Identical twins are of peculiar scientific interest, for they are the product of the symmetrical division of a single embryo, derived from a single fertilized egg," according to Professor Newman. "Such a fertilized egg typically develops into a single individual with a body composed of two nearly symmetrical halves. A pair of identical twins starts out to become an ordinary single individual with right and left symmetrical halves, but some delay or some hitch in the developmental process causes the right and left half embryos to separate and each half to grow into a whole individual."

Identical twins are always of the same sex in a pair and have the same or nearly the same eye color, hair color, skin color, nearly the same irregularities in their teeth, nearly the same finger-prints, nearly the same shapes of ears, nearly the same features, body build, etc.

"There is an old problem that badly needs solution, namely, which is more important in the development of an individual, differences in heredity or differences in the environment," Professor Newman said. "If we could find two individuals with exactly the same heredity and rear them under different environments we could conclude that the extent to which they remain similar is a measure of their heredity and the extent to which they become different under different environments is a measure of the effectiveness of the environment in producing differences. It is in just this connection that identical twins come to our aid, for they represent for each pair two individuals with identical heredity.

"So far we have studied five cases of identical twins reared apart. The results indicate that the environment very distinctly modifies some physical characters such as weight, general health, etc., but does not alter others such as eye color, hair color, teeth and features. The environment profoundly modifies those characters described by the terms intelligence and personality. After full credit is given to the modifying effect of environment, the fact stands out sharply that hereditary resemblances remain most strikingly close.

"I earnestly wish we could find and study about five more cases such as these. If we had ten cases and they were as consistent as those already studied, we might be able to arrive at some very definite conclusions as to the relative effects of heredity and environment in producing human differences."

Any one knowing of cases of identical twins reared apart was urged to write directly to Professor Newman at the University of Chicago.

MEDICAL ADVERTISING

A CHANGE in the twenty-century-old code of ethics which now governs medical practice was suggested at the recent meeting of the American College of Surgeons by its newly-installed president, Dr. Allen B. Kanavel, professor of surgery in Northwestern University Medical School in Chicago.

"When we see the exploitation of the poorly informed public by charlatans and medical hi-jackers, we must meet with constructive suggestions the desire of ethical institutions and public-spirited organizations to eradicate this evil, must realize the distinction between advertising for personal and selfish ends and that for the education and welfare of our people, must acknowledge that the principle of protection of the public for which our code was established may be better served by some change in our conception of the application of our rules," Dr. Kanavel declared.

Minds free from "guild arrogance, guild complacency and guild fundamentalism" are needed to solve the problem of giving the public competent medical service at a price it can afford to pay, Dr. Kanavel pointed out.

"There is some justification for fundamentalism in social concepts but none in science," he declared. "Contract practice is probably the most important question confronting us to-day," he said in discussing schemes for solving the problem of medical economics. "It behooves us to give careful consideration to this so-called organization of individuals, industry and institutions to employ incompetent individuals for service."

He also suggested better cooperation between the public and the physicians. "A knowledge of the attainments of modern scientific medicine must not be the peculiar birthright of the physician but must become a part of the common heritage of the everyday citizen," he commenfed. "Far from resenting the inquiry of the public as to our aims and ideals, we must welcome the association of the constructive mind of the well-informed layman in the solution of the great problems and the application of our discoveries to the benefit of mankind."

THE CONCENTRATION OF THE SUN'S RAYS

A HUGE "burning glass" made of nineteen lenses each two feet in diameter, as well as nineteen smaller ones, will soon be in operation at the new Astrophysical Laboratory of the California Institute of Technology. With its aid, it is hoped, temperatures as high as those in the sun-spots, around 10,000 degrees Fahrenheit, will be attained, and astronomers will be able to study at close range how various substances behave when so heated.

The new instrument has been developed by Dr. John A. Anderson, of the Mount Wilson Observatory, who origi-

nated the general design of the lenses, and Russell W. Porter, who worked out the practical details of a mounting for the instrument, so that it can follow the sun as it moves across the sky. The sun's light and heat first fall on the nineteen two-foot lenses, which, by themselves, would bring the rays to a focus at points twelve feet away. A set of eighteen mirrors reflects each beam to the center, where it meets the other beams. Before reaching the center, however, each beam passes through a smaller lens, seven inches in diameter, which concentrates it still further. The beam from the center two-foot lens passes directly into the second lens without reflection from a mirror.

At first, the large beam of sunlight which supplies the whole battery of lenses is ten feet in diameter, but at the final focus of the instrument it is reduced to an area the size of one's little fingernail, so that the energy is concentrated about 200,000 times. The material to be studied will be placed in an evacuated glass bulb, made large enough not to be melted by the intense heat. As the material vaporizes under the temperature—and no substance is known which will withstand it—it will give off light, which will pass into an adjacent dark room, where it can be analyzed by powerful spectroscopes.

The erection of the new Astrophysical Laboratory, of which the solar furnace will be part, is one of the steps in a new program being undertaken at the California Institute of Technology, in studying the phenomena that occur in the heavens. The 200-inch telescope, double the size of any existing at present, which is now under construction, is part of the same program.

SULPHUR FROM POPOCATEPETL

FOR the first time in twenty years negotiations are going forward for the privilege of taking sulphur out of the crater of Mexico's quiescent volcano, Popocatepetl, for commercial purposes. American interests are reported involved in the project.

The last important concession obtained from Mexican authorities for this purpose was granted during the administration of Porfirio Diaz and was held by his friend, General Gaspar Ochoa. Ochoa's operations were halted because of the revolution which broke out in 1910.

In the past the sulphur has been hauled up to the top of the crater in a large basket, which was accomplished by means of a rope and pulley. Usually it is carried from the crater to Tlamacas down the mountainside on the backs of Indians. Burros have been the means used to transport the sulphur, which is in the form of brimstone, from Tlamacas.

It has been found necessary to grant Indians working in the actual crater two days' leave between each day of work, because of the stifling sulphur fumes. The crater is three quarters of a mile wide and approximately five hundred feet deep. In the center is a small, emerald-green lake.

The brimstone which collects about the crater periodically catches fire, but only the surface of the brimstone burns. So-called eruptions of Popocatepetl within recent years have been proved by expeditions from the National University of Mexico to be nothing more than enormous amounts of smoke from the burning brimstone. Sulphur has been taken intermittently from Popocatepetl since the time of the ancient Aztecs, who used it for medicinal purposes. Two of Cortez' soldiers, in the sixteenth century, climbed to the crater and obtained sulphur for the purpose of manufacturing gunpowder.

ITEMS

RED vinegar that looks like clear Rhine wine, smells like pear oil and tastes like old whiskey, comes from the pulp of the coffee-berry. About 40 per cent. of the berry is bright red pulp, 9 per cent. of that sugar and 8 per cent. tannins, Mr. F. W. Reise, chemist, says. Unripe mash made from the pulp contains acid, while overripe mash develops methanol from pectin. By-products have had little utilization. Coffee is the twin-seed of a cherry-like berry that grows on a bush.

INSECTS are better subjects for use in vitamin tests than are the conventional white rats and other larger laboratory animals. This is the claim of Dr. M. D. Sweetman and Professor L. S. Palmer, of the University of Minnesota, who have been trying out various foods on the larvae of a species of flour beetle. They gauge the insects' reaction to a given diet by the time elapsing between their emergence from the egg and the end-point of larva-hood, when they become chrysales or pupae.

A BOTTLE traveling ten miles a day in the water was the winner of a long-distance swim for bottles staged in Lake Michigan last summer by the U. S. Bureau of Fisheries. During the summer the steamer *Fulmar*, operated by the Fisheries Bureau, released 283 bottles in the lake, in an endeavor to determine the various surface tendencies of that important body of water. To make the investigation a success, it was necessary to depend upon the courtesy of the various bottle-finders in complying with a note inside asking that the bottle be returned to the bureau's office at Ann Arbor with information as to the date and place where found. The winner of the bottle race, released at St. Joseph, Michigan, was found 20 days later at Sleeping Bear Point in Leelanau County, 200 miles away. The information thus being gathered concerning the currents of Lake Michigan will be of value to commercial fishermen along the lake as well as to navigation.

DOGS with mottled teeth, an endemic condition of the enamel produced by the presence of fluorine in drinking water, have been achieved experimentally by Dr. Margaret Cammack Smith, of the department of home economics at the University of Arizona. Six months ago, Dr. Smith completed her experiments with the drinking water at St. David, Arizona, and determined that fluorine in the drinking water at that place was responsible for the existence of mottled teeth. At first the mottled condition was only produced experimentally in white rats, but now for the first time this condition has been given to the larger animals. The mottled condition has been produced after a six months' feeding experiment.