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THE ORDER AND DISORDER OF MATTER

A FEW years ago when scientific men gathered to discuss the possible structure of solid matter they dwelt in great detail on the orderliness of things. The disorder of matter as a key to its structure was discussed recently at the symposium on the structure of metals held at Cornell University.

Professor John C. Slater, of Massachusetts Institute of Technology, indicated in his introductory remarks that crystal structure, with its regular arrangement of atoms is now fairly well understood. But the more real solids like metal alloys are studied the more they are found to differ from the idealized crystal states that can be interpreted so well. The emphasis now is on studies of disorder. In fact, mathematical physicists have introduced a new concept into their calculation, the degree of order or disorder which a given material may have. This searching for knowledge in chaos, as it might be termed, complicates the discussion of phenomena and increases mathematical difficulties, but it has had the net effect of finding out more about solid structure. In analogy mathematics has called up additional symbolic reenforcements as the going became harder.

Professor Slater indicated that in solids it appears that there is both a long-range and a short-range order "These terms mean," he added, "essentially just what they say: a structure shows long-range order if each part fits into a pattern extending through the whole structure, while it shows short-range order if each atom is surrounded by neighbors in a regular way, though the regularity may not persist for a very large distance." This is like saying that a town would exhibit long-range order if all its dwellings (as in some older company-owned mining town) were made alike. Short-range order, by the same picture, would show a series of what might be called subdivisions, within which all the dwellings were alike, but differed from region to region.

The advantage of the new concept of order and disorder is that it permits investigators to discuss mathematically, and predict, phenomena in which the atomic particles are not in equilibrium with one another. Thus the great branch of physics known as thermodynamics is extended to new usefulness, for thermodynamics, highly valuable though it is, can only apply to equilibrium conditions. And yet in real life and real things like alloys of metals the idealized equilibrium conditions seldom exist. Alloy steel, for example, may be in equilibrium when it is made at high temperatures, but equilibrium may not then exist at room temperatures where it is used in practical life.

THE NEW HEAVY ELECTRON

THE new heavy electron, weighing about fifty times as much as the ordinary kind, was predicted by the Japanese scientist H. Yukawa as early as 1934, according to a report in the current issue of *The Physical Review*.

Professor E. C. G. Stueckelberg, of the Institut de Physique, Geneva, reports that both he and Dr. Yukawa independently arrived at an explanation of the forces within the atom which predicts such a heavy electron as is now being discussed by physicists. Drs. J. C. Street and E. C. Stevenson, of Harvard University, and Dr. Carl Anderson and Dr. Seth H. Neddermeyer, of the California Institute of Technology, form two research groups that have found indications of the heavy electron. The heavy electron, according to Professor Stueckelberg, is predicted by equations which describe matter by a mathematical operator known as a spinor, having 16 components or parts. Four components refer to the electron state of the atom, four more to the neutrino state of the atom, another four to the proton state and the last four components to the neutron state of matter. According to Professor Stueckelberg's theory the new-found heavy electron is very unstable and can only be of secondary origin created out of some of the particles now known. Four other particles, yet undiscovered, are also predicted by the theory.

CHANGE IN LUNAR MARKINGS

WHILE astronomical findings indicate that the moon is lifeless and, indeed, probably without an atmosphere, there are some matters of lunar topography that need more explanation. Appearing in *Popular Astronomy*, published by Goodell Observatory of Carleton College, are drawings made of mountains on the moon which show changed markings from time to time that must be attributed to something—haze, melting snow or jets of steam.

Pico, an 8,000 foot peak on the moon, was the mountain chosen for study by G. O. Rawstron, amateur astronomer of Liverpool, England. Some 48 drawings of the mountain, made with a four-inch diameter telescope, show that light and dark areas on the lunar mountain vary from time to time. Mr. Rawstron states that it is practically impossible to reconcile these changes with the effect of the varying angle of illumination. There are certain markings which actually darken as the lunar mid-day approaches; certain others vary considerably in shape and size during the course of a lunation, the interval between the returns of consecutive new moons. "Most striking of all, however, are those areas which undergo an irregular change in appearance from one lunation to the next—that is to say, which do not present the same aspect at similar co-longitudes." The most conspicuous marking observed is a white area which spreads out from the northeast corner of the mountain and extends over a great plain, known as the Mare Imbrium, for about 22 miles. Whether this is a haze or a jet of steam of perhaps volcanic origin is unknown.

Professor W. H. Pickering, emeritus professor of astronomy at Harvard College Observatory, who now maintains a private observatory at Mandeville, Jamaica, has been one of the leading scientific men who have noted similar changes in the markings on the mountains of the moon. The choice of the mountain Pico for study by Mr. Rawstron was, in fact, due to an earlier study of the same mountain by Professor Pickering. While the new drawings differ slightly in appearance from those made by

Professor Pickering the major features of change are substantiated by the new work.

THE PATTERN OF SLEEP

WHEN you wake up after a sound night's slumber you may feel as though your rest was unbroken and continuous all night long. Really, though, you went through a changing pattern of deep sleep, stirring movement, near-arousal and then sinking down into the depths of quiet sleep again. This pattern is repeated over and over throughout the night, but as morning approaches the depths of sleep become shallower and the sleeper is easier to awaken.

This pattern of sleep was found in the course of experiments conducted at the department of physiology of the University of Chicago with both dogs and human beings. By electrical means the tossings and stirrings of the sleepers were recorded and measurement was made of the degree of noise required to disturb them. Each person seems to have his own pattern of movement and level of sensitivity to noise, and he tends to follow this pattern more or less regularly, according to the report of Drs. F. J. Mullin, N. Kleitman and N. R. Cooperman, in the *Journal of Experimental Psychology.*

The ease with which a person can be awakened is related to the length of time since he last moved, rather than the time of the night. Individuals differ in both restlessness and soundness of their sleep, but the differences are not always in the same direction for both factors. On the average, the most quiet sleeper is the one most easily aroused, it was found. In a normal night's sleep, the greatest amount of tossing and also the most frequent spontaneous awakenings of the sleeper come in the last few hours of sleep. Toward morning the sleep becomes shallower and shallower. Sometimes, however, the sleeper will settle down toward the end of his sleep for about 45 minutes of quiet deep slumber like that enjoyed during the first of the night. During the course of the night, the test subjects sometimes would stir, wake and press a signal key to inform the investigator they had roused, and yet not recall the act in the morning. The sleep of dogs is similar. They enjoy their deepest slumber about half an hour after they fall asleep.

THE PRODUCTION OF REGULAR FRUIT CROPS

FRUIT trees are made to produce regular crops, and on time, too, regardless of the previous winter weather, it is claimed in a patent granted to Daniel Glenn Sorber and Marston H. Kimball, of the U. S. Department of Agriculture, and assigned to Henry A. Wallace as Secretary of Agriculture. This is accomplished by gas-attacking the trees with butylene, a common hydrocarbon gas.

There are thousands of acres of walnuts, peaches and other deciduous fruits, including apples, pears, apricots, plums, prunes, cherries and bush berries now planted in areas where in certain years winter weather conditions are unfavorable to the formation of flowers, the setting of fruit, and the production of a crop. This condition results in failure of trees to produce regular crops, occasioning heavy losses and often seriously crippling the industry. Such fruit trees as lemon and avocado also exhibit marked alternate bearing tendencies. The result is a heavy production one year, followed by lighter producing the next, with attendant cultural and marketing difficulties which produce economic losses.

The process used by the inventors to stimulate growth and produce uniformity in fruiting is this: About two weeks before the normal or desired leafing, start of the growth cycle, or blooming time for the variety of trees being treated, the trees are enclosed in tents or gas-tight covers. Then butylene gas is released inside the tent until the proportion of gas to the atmosphere is 1 part of butylene to 100,000 parts of air. The temperature during treatment is kept between 60 and 100 degrees Fahrenheit. The length of treatment is from one to two hours. Gas and other chemical treatments have been used in the past to stimulate opening of cut flowers, production of roots on cuttings, etc., but this is the first time whole trees have been gassed to make them blossom at the desired time.

GRASSHOPPERS IN COLORADO AND KANSAS

INVADING millions are on the march, carrying a threat to the crops of eastern Colorado and western Kansas. I have seen them trekking across the plains, almost as if the earth itself in this dustbowl region were moving. The predicted plague of grasshoppers has arrived. Ranchers and farmers of this region are joining state and federal officials in poison warfare against them.

The grasshopper of the plague hereabouts is small. This long-winged grasshopper of the plains, entomologically known as *Dissosteria longipennis* Thomas, is now only a half to three-quarters of an inch long. He is dust-gray in color, and when he jumps he shows yellow, green and brown splotches and a cream-yellowish belly. His lack of size is made up for by numbers. Dozens and scores are found in a square foot, which means millions per acre in the thicker, larger hordes.

At the Denver meetings I heard of the grasshopper invasion growing more serious hour by hour. At Hugo, Colo., I joined an anti-grasshopper council led by F. A. Anderson, agriculture extension director of Colorado. With him and the Lincoln County agent, D. L. McMillen, I saw the monotonous, persistent advance of the grasshoppers across yellow- and red-flowered cactus-studded ranges from which the wind constantly whipped up fine dust. I charged through the millions of hoppers with an automobile that killed hundreds with each turn of a tire. Heavily traveled Route 40 is swarming for a distance of five miles with grasshoppers hurrying to more food. It is a swift and earnest march for these migrating grasshoppers just now. They put one foot in front of another and jump only when they are scared and really must. The aviation phase of their advance is still to come, due not long after the beginning of July. When they do fly they will travel much faster and be more dangerous. At present they are moving a matter of miles per day. One curious person here painted some of them with luminous paint and found that that particular army traveled two and one-half miles in an eight-hour period. Just where they came from this year the insect experts could not tell me.

Those I observed were headed north, and that may mean that they were hatched farther south in Colorado.

The only way to attack them now is by means of poisoned food. I saw great troughs of old sawdust, bran and deadly sodium arsenite being mixed. This bait is spread in the fields in the path of the advancing hoppers. S. C. McCampbell, extension entomologist of Colorado, designed a mechanical spreader for this bait, with which three men can distribute as much as 25 men with shovels.

In this respect there is a shortage of material and men, despite the whole-hearted aid with trucks and men of the U. S. Soil Conservation Service forces. Dr. H. H. Bennett, its chief, motored through here and pledged continued aid to agents and commissioners of nine Colorado counties assembled. I was told that Army regulations have prevented nearby CCC camp men from joining in this war that is of more than local importance. The danger in handling the poison used is the reason given for withholding CCC aid.

Dr. E. D. Ball, state entomologist of Arizona, stated at Denver that grasshoppers normally get a quarter of the grass on the ranges that stock should be eating. They will get much more than that this year.

—WATSON DAVIS.

ITEMS

THE great planet Jupiter is now visible throughout the night. For many months the earth has been swinging closer and closer to its giant brother, and at 3:00 A.M., eastern standard time, July 15, the two orbs are but 384,592,000 miles apart. Because it is so close, relatively speaking, Jupiter is now unusually bright, and can easily be found in the southeastern sky during the evening. At midnight it is directly south. The earth encircles the sun at an average distance of 92,870,000 miles, while that of Jupiter is 483,200,000 miles. But instead of going around the sun once a year, like the earth, Jupiter goes around in nearly twelve years

A 10-MILE-LONG deposit of soapstone, including solid hills of the mineral, have been discovered in Wake County, North Carolina, in a WPA project directed by Edgar B. Ward, North Carolina geologist. Millions of tons of the mineral, formed millions of years ago by volcanic eruption, will form a great reserve which some day will supply material for a profitable industry. It has been used in the past for the tops of laboratory tables, for hearths and mantles, flooring, laundry tubs and sinks.

FANTASTIC prices were paid in the Netherlands in the seventeenth century for rare bulbs. Among those most highly prized were bulbs that gave rise to flowers with "broken" colors—contrasting patches of color in certain parts of the petals. "Broken" tulips have since come to be recognized as a disease, but what caused this abnormal patterning remained a mystery. Now, Dr. Frank P. McWhorter, of the U. S. Department of Agriculture, reports that ten years of study have proved "breaking" to be due to the interaction of two virus diseases. Dr. McWhorter, working at the Oregon bulb station, found that Virus I removes color from tulip petals and causes mottled foliage. A fairly pure virus soon kills the plant. Virus II adds color and does not seem to injure the plant. Equal parts of Virus I and Virus II cause symptoms almost as severe as Virus I alone. But when a mixture of ten parts of Virus II and one part of Virus I is injected into healthy plants it causes a typical "breaking." If the infected tulip lives and divides, the two are in working balance.

OFFICIALS of the Japanese Government Railways have been puzzled for many years by reports from various parts of the country that the rails of tracks under operation were found to shorten in length with time. Desiring to probe the reports, the laboratory of the Japanese Government Railways dispatched experts to a track which had not yet been opened. For several years, while they were in operation, the small rails were measured over and over again. Yoshiji Hiramatsu, head of the investigating group, offers a fact and a conjecture. Fact: that the Japanese Government Railways' web of rails contracts at the rate of several miles a year, quite apart from temperature fluctuations. Conjecture: that the principal cause of this phenomenon is train vibration, which removes the initial stresses.

NOW available through the U. S. Forest Products Laboratory, at Madison, Wis., to any nurseryman in the country, are the plans for a cone kiln designed to obtain the ripe seed cones of evergreen trees in half the time required by older equipment. Practically fireproof, the kiln has low maintenance and depreciation costs, and boasts adaptability to the varying conditions necessary for drying seed cones ranging in size from tiny hemlock cones to long sugar-pine cones. With comparatively little expense, viable seeds suitable for immediate planting or for storage are obtained readily by circulating through the cones large volumes of air, with controlled temperature and relative humidity. Kiln walls and ceiling panels are attached to a steel frame, which supports two 24-inch overhead electric disc fans and steam heating coils. If steam is not available, an ordinary house boiler will supply enough heat. The seed cones are spread on wire mesh trays, 3 by 4 feet, nested on top of one another. Thirty-three to 35 bushels of cones is the capacity. The first kiln of this type has been installed at nursery headquarters of the Ozark National Forest in Arkansas.

PREVENTING silicosis by adding dust to the air sounds like a strange paradox, since silicosis is the lung disease resulting from breathing dusty air containing silica particles. Yet prevention of this disease, to which a million or more American workers are exposed, may in future be accomplished by fighting dust with dust. This is the possible solution of the silicosis problem suggested by results of a mineralogical study by R. C. Emmons, professor of geology, and Ray Wilcox, of the University of Wisconsin. The idea is to add protector mineral dusts to the air containing silica dust. Scavenger cells function poorly in removal of colloidal silica or any pure mineral dust. However, inhalation of one or more additional dusts, whose electrical charges are opposite to that of the noxious material, may result in aggregation of all dusts into large particles which can be normally removed before chemical action occurs.