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PAPERS READ BEFORE THE AMERICAN PHILOSOPHICAL SOCIETY

STRUCTURAL MODELS OF ATOMS

IN his Franklin Medal lecture on April 24, Dr. Hugh S. Taylor, David B. Jones professor of chemistry at Princeton University, described his studies with atom models 100,000,000 times natural size. He credited his student, Bernard Becker, with working out many details.

By studying the effects of various substances on beams of electrons or x-rays, it is possible to deduce the arrangements of the atoms to form their molecules. The individual atoms are so small, however, that even the new super-power electron microscope would have to be twenty times more potent to observe them individually.

Knowing the arrangement of the atoms, models may be made of special little wooden blocks. Formerly these were held together with pegs, but now they are joined with snap fasteners, like those used in clothing. These have the advantage that long chains may be subjected to various kinds of handling without falling apart.

He finds that the silk protein, fibroin, consists of long chains of links called peptides. Each consists of atoms of carbon, hydrogen, nitrogen and oxygen. The silk fibroin chain is fully stretched, but with hair and wool protein, or keratin, there are at least three forms. In one the links are folded, but when stretched, it resembles the silk.

Dr. Taylor stated that "The stretched form, or beta-keratin, is not the normal form of hair keratin. Normal or alpha-keratin must be a folded structure. It is these folds which are drawn out when the fiber is stretched and the stretched condition may be 'set' by exposure to steam heat while the tension is maintained. It is this process of 'stretching' and 'setting' which has attained the dimensions of a fine art, common to both sexes, in the 'permanent wave' and 'set' and in the 'trousers crease.' As is also well-known to both sexes, this imposed change is only temporary, the hair or wool reverting gradually to its normal folded alpha-keratin structure." He also found that muscle fiber, or myosin, has "the extension and contraction characteristic of hair fiber." The contraction and return to normal, he stated, are chemically induced.

Perhaps these studies may aid in a better understanding of cancer. Models were made of stubstances that cause cancer. It was found that there appeared to be some correlation between their power to produce the effect and the extent to which the atoms were all in one plane or not. The structure of vitamins, hormones, sulfanilamide and other new drugs is being studied. From these, perhaps, it will be possible to find out how they work in the body.

COSMIC RAYS

The cosmic rays that continually bombard the earth from outer space seem to be mostly of protons, the heavy parts of atoms, rather than electrons. New evidence in favor of this theory is contained in experiments reported by Dr. Arthur H. Compton, of the University of Chicago.

He told of various measurements made of the cosmic rays far above the surface of the earth, from airplanes and balloons. Some of these measured the number of particles that came in which were capable of penetrating thick blocks of lead. It was found that most of the particles which could get through an inch and a half of the metal were able to traverse some seven inches. Many electrons are stopped by the magnetic field of the earth. Those with enough energy to penetrate this field, and so to reach the lead blocks, should be stopped by only four inches of lead. On the other hand, the observations fit in with the idea that protons, with positive electrical charges, are the primary cosmic rays. When these strike the nuclei of atoms in the air, they produce mesotrons, which constitute an important part of the cosmic radiation observed on the earth's surface.

Dr. Compton also reported observations by V. C. Wilson, W. P. Jesse, M. Schein and E. O. Wollan, who used detector tubes carried aloft in airplanes and balloons. These showed that an inappreciable number of mesotrons are produced below 3¾ miles' altitude. At about 5 miles the production becomes strong, and increases up to at least twelve and a half miles. "At the highest altitude, where the barometer is two centimeters of mercury, the number of mesotrons is at least as great as the number of incoming cosmic ray particles as estimated by Millikan and his collaborators."

Another experiment by G. Herzog and W. Bostick made use of a cloud chamber between the poles of a powerful magnet. The chamber shows, by a fine line of water droplets, the passage of one of the various particles. With it there were found many slow mesotrons, which are exceedingly rare at ground level. The production of positive and negative pairs of slow electrons was also noticed.—JAMES STOKLEY and FRANK THONE.

THE NATURE OF INTELLIGENCE

Intelligence is only a probability that the person possessing it will act in a certain way under certain conditions. It is not an inner essence or a faculty of power that can be isolated and measured as the chemist can measure the elements. This view of mental abilities was expressed by Dr. Edward L. Thorndike, of Teachers College, Columbia University.

"Three or four hours' testing of a person with suitable intelligence tests or meters," Dr. Thorndike said, "gives a score which is highly indicative of how well he will do in school, how likely he is to escape confinement in an institution for the feeble-minded, and how well he will understand the sermons he hears, the policies for which he votes, and the like. It is usefully indicative of his fitness to make wise decisions as a parent, neighbor and citizen. Such a score obtained at age eight to eighteen is equal or superior in value to a careful physical examination at that age by an expert physician."

Psychologists would like to be able to isolate each individual mental ability, as the chemist does his elements,

and measure all of it and nothing but it. But unfortunately for science and perhaps fortunately for man, mental abilities do not occur in pure form in any person. Each score that the psychologist can obtain from his measures is contaminated by the influence of other abilities—it is a mixture. By the mathematical procedures known as factor analysis, components or factors have been isolated that would be pure if we could get measurements of them in real people, but psychologists vary widely in their opinion of the result. "Some expect that the factors discovered will inaugurate great advances in knowledge about, and control of, human abilities. Some think that these factors are unrealizable abstractions, like an animal defined as 40 per cent. man, 30 per cent. turtle, 20 per cent. shark and 10 per cent. earthworm."

Dr. Thorndike stated that psychology will not be satisfied until it succeeds in relating mental abilities to their causes, bases, parallels or counterparts in the brain and nervous system. Not much is known along this line at present, although some former errors have been eliminated. "We now know that a brain is not much like a system of factories and storehouses interconnected by railroad tracks. It is more like a telephone and telegraph system with the added feature of more or less permanent modification by all the connections made and messages sent. It may include an elaborate system of resonators. What corresponds to an ability is more like a system of connections and modifications involving all army or navy activities than like a regiment of cell-bodies. The cell-bodies indeed may only nourish and care for the conducting parts of the neurones. What the pattern of the neurones' actions is may often be more important than which particular neurones they are."—MARJORIE VAN DE WATER.

MILITARY PSYCHOLOGY

The lead in military psychology has passed from America to the Nazis, according to Dr. Robert M. Yerkes, of Yale University.

In the World War, American psychologists pioneered by making their methods serve the Army and Navy. Dr. Yerkes is himself distinguished for the services he rendered the nation at that time, particularly in the development of the psychological testing and classification system which has been used successfully in industry ever since.

But after the war, Dr. Yerkes said, America neglected the field of psychology applied to the service of the state, while Germany took the initiative and leadership. Research and training centers were established in Germany and hundreds of men were trained for psychological service to the state.

Now the Nazis have an unparalleled organization to deal with problems of propaganda, morale, personnel and like matters of human engineering. The United States has no comparable organization, few military psychologists, and no training schools in Army or Navy to meet prospective needs.

Dr. Yerkes pointed out that psychology has other than military values for defense. "In the interest of social progress it would seem incomparably more important to improve human nature and increase the ability and usefulness of the individual, than, in accordance with our current concentration of effort, to prolong life into senility." He urged the establishment of professional schools of psychology, similar in principle to those of medicine and engineering, with courses leading to the degree of Doctor of Psychology. For those who wish to practice their profession licensing under federal and state laws should be provided.

MOTIVATION, LEARNING AND ADJUSTMENT

Dr. Edward C. Tolman, professor of psychology at the University of California, stated in the R. A. F. Penrose, Jr., Memorial Lecture that in his opinion the World War and the "ghastly picture which the international scene exhibits" are due to irrational and diseased mental processes, especially in Germany.

The recent fad of working off anger by smashing a plaster figure with a satisfying noise is an example of the same sort of irrational thinking displayed by the Germans, who feel that they can overcome the barriers to their own well-being by smashing other nations. This irrational process is known to psychologists as "displaced aggression." Because of the fact that it is irrational, such a diseased way of thinking can not readily be overcome by logical argument or education. Another such irrational and diseased mental process is termed "group identification." It is what makes the German feel that the successes of the German Army and the Nazis are actually equivalent to his own individual happiness and success. These irrational mechanisms have their start when, often in early childhood, the individual can not get things essential for his own well being. He then substitutes, illogically, the successes of his family, school, economic class, nation, or even "hemisphere," and the leaders of these groups, as though they were identical with his own success.

Germany's relatively Spartan system of childhood training, as well as the hardships suffered recently by the German people, is blamed by Dr. Tolman for the widespread development there of diseased thinking. "The only cure for Germany," he said, "would be a less rigid and Spartan system of training and a less mystical belief in German 'Blut und Boden.'"

Dr. Tolman pointed out that in Italy, due to type of family and school discipline, youthful frustrations are probably not so great as in Germany and come more from the actual poverty of the country. Their diseased "identifications" are less in Fascist Italy, and less successful, than in Nazi Germany.

In America, the essence of our democracy has been, in the past, the ever-repeated breaking down of tendencies toward such irrational identifications with the state and its rulers. Our free family life, schools and democratic political procedures have insured that the welfare of the group or its leaders should not be regarded as more important than the welfare of the individual. "But today," according to Dr. Tolman, "all is threatened. We Americans, like the denizens of the Old World, are beginning to talk primarily about group survival, group success, group enemies."

We need to ask ourselves, he said, how far this is logical and how far we, like the Germans and Italians, are indulging in irrational, diseased group identification—

how far the depression and recession, the horrors of unemployment and all the consequent suffering and frustrations have led us into displacing our aggressions against enemies abroad rather than against true barriers at home. In any case, he said, if the thinking is irrational and diseased, it grips us and we can not give it up. If it is rational, we don't want to.

He sees only two ways out. We must work for some larger, more powerful, more international group to emerge from this war in which our children and our children's children can more safely and happily "identify." And we must see to it that the sacrifices demanded of individuals here are not so unreasonable as those demanded in Germany, remembering that only the well-being of individuals can build a good and worthy society.

"A surviving America," he said, "with the same soil erosion, pellagra, discrimination against racial minorities, and unemployment will not have been greatly worth the throwing away of our steel, our oil and our sons."—MARJORIE VAN DE WATER.

THE GROWTH OF CANCER

That cancerous tissue growing between the pupil of the eye and the curved, transparent front surface can be watched as if through a window, and studied in detail with a microscope, was reported by Professor Balduin Lucké and Dr. Hans G. Schlumberger, of the University of Pennsylvania. Their investigations have led to new knowledge of the way a cancerous growth spreads.

Professor Lucké states that "such observations have led to the conclusion that the pattern of cancerous growth is influenced decisively by surface forces. Thus, if the outgrowths from the cancer extend into the cavity of the eye where they are completely surrounded by fluid, and where in consequence interfacial forces are equalized, the resultant form is cylindrical. If, instead, the outgrowths make contact with a firm surface such as the lens, the interfacial relations become such that the edges of the growing tumor are drawn over the lens, forming a spreading membrane. If, however, the proliferating tumor pushes into the clefts of a loose tissue, such as the iris, the invading cells become arranged as spheres or cylinders, again through the operation of surface forces."

It was also possible to study cancer growth through a far wider range of temperature than is possible with higher animals, because the frog is cold-blooded. Growth was observed at temperatures ranging from only a few degrees above freezing to that of a warm summer day. Low temperatures retarded growth, high temperatures speeded it. At low temperatures the outgrowths were short, stubby, solid, whereas the more rapid growth induced by warmth produced long, branching outgrowths that tended to become bulged with fluid.—FRANK THONE.

THE CAROLINA "BAYS"

New evidence on the formation of the mysterious "bays" in the Carolina coastal plain was offered by Professor Douglas Johnson, of Columbia University. These "bays" are not arms of the ocean, but shallow elliptical or pear-shaped depressions in the sandy plain, their bottoms now filled with alluvial soil, sometimes swampy, sometimes dry. It has been suggested that they were all made by a single bombardment with fragments of an enormous meteorite that shattered as it fell, but Professor Johnson and a number of other geologists are now convinced that they originated through the action of huge natural artesian springs bringing great volumes of water to the surface from subterranean streams.

One of the arguments for meteoritic origin of the depressions is that their longer axes all trend in the same direction, as they would if they had been plowed up by a great charge of super-shrapnel. However, Professor Johnson pointed out, their axis-direction is not uniform: in parts of the country it is northwest-southeast, but elsewhere nearly straight north-south. This could be better explained by seeking the cause in the direction of water currents shifting the material loosened by the springs, sometimes in the direction of the surface slope, sometimes in the direction of the slope or pitch of subsurface rock structures. The springs themselves would tend to shift up-current, resulting in the formation of elongated craters. If the spring flow remained uniform, the elongated crater would become an ellipse; if the flow increased, the crater would enlarge as it migrated, becoming pear-shaped. Direction of flow of ground water would also deflect the upwelling water of the springs, causing migration of the craters, and hence changing their shapes.

Characteristic of the "bays" is a pile-up of sand into a low ridge at one end, usually the southern or southeastern end. Professor Johnson explained this by pointing out that the loose sand carried up into the lakes formed over the craters would respond to the effects of lake currents by piling up on the down-current side of the crater wall, whereas on the more agitated up-current side it would be carried out and spread more uniformly on the lake bottom.

OTHER PAPERS

Production of diphtheria antitoxin in crystalline form was announced before the meeting by Dr. John H. Northrop, of the Rockefeller Institute for Medical Research Laboratories at Princeton, N. J. The first step was the formation of a precipitate, by mixing diphtheria toxin with serum from a horse which had been immunized against the toxin. This precipitate is a mixture of toxin and antitoxin. The toxin was digested away with trypsin, one of the digestive enzymes, leaving the antitoxin in solution. Further treated with ammonium sulfate, the solution yielded a more highly purified, unstable, crystalline protein in the form of small plates. This protein has antitoxic properties, which remained unchanged after three recrystallizations.

Professor G. H. Parker, of Harvard University, stated that catfish have two ways of darkening their skins but only one way of turning themselves pale again. Nerve-end action, producing the compound known as acetylcholine, causes partial expansion of the melanophores (dark bodies in the skin), and a gland secretion, called intermedine, completes the darkening process. The dark bodies are caused to contract by the action of the familiar gland secretion, adrenalin, making the fish pale again. Heavy doses of acetylcholine injected into fish may cause death, but intermedine does not have injurious effects even in very large quantities.