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THE NEW QUANTUM MECHANICS

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PROFESSOR ALBERT EINSTEIN'S first paper on the new quantum mechanics is soon to appear under the title: "Semivectors and Spinors." He has allowed his colleagues in theoretical physics at the California Institute of Technology to have an advance view of some of the ideas contained in this forthcoming paper which will be published in the *Proceedings* of the Prussian Academy at Berlin with Dr. Walter Mayer as the collaborating author.

Professor Einstein is careful to explain that most of the results had already been discovered by other workers. But he wrote the forthcoming paper at the request of his friend, Professor Paul Ehrenfest, of Leiden, to clarify this little known subject.

His discussion with the theoretical physicists was, of course, technical. To make it easier for his American listeners Einstein spoke in English. This is the first extended discussion that he has delivered in English. Usually he speaks in German in order to express himself more precisely and clearly. His English is, however, quite good.

Semivectors are related to vectors in somewhat the way that imaginary numbers are related to real numbers. The spinors are restricted semivectors. The vector concept is fundamental in relativity because it enables one to avoid irrelevancies. Thus it helps to discover new laws.

The semivector may suggest new physical laws also, for it has the same simplifying properties as the vector. As in the case of the vector, the semivector can furnish tensors. The famous equations of Lorentz can be written for semivectors, but no important change is involved. The Dirac equation for an electron can be derived in an elegant manner, but Professor Einstein pointed out that it was not the simplest case of its type.

He said that it would be interesting to study the simplest case. Then he went on to say that semivectors could be used to advantage in generalized relativity, but that unlike vectors they led to complicated equations.

When Professor Richard C. Tolman, of the California Institute of Technology, asked for a physical description of a semivector, Professor Einstein confessed that he had been unable to think of any geometrical or physical picture, but added that with mathematical analysis the subject could be handled with great ease.

THE UNCERTAINTY THEORY AND THE ELECTRIC FIELD OF A PARTICLE

ABBÉ GEORGES LEMAITRE, the Belgian priest-professor of the University of Louvain, who has been visiting here, has extended the uncertainty theory of physics to the electrical field of a particle.

Professor W. Heisenberg, the German physicist, by developing his uncertainty principle, which held that it was impossible to know accurately the place and speed of an object at the same instant, introduced a concept of wide philosophical consequences.

Now in a letter to the *Physical Review*, Abbé Lemaitre develops formulae which allow him to conclude that for instantaneous determinations the electromagnetic field of an electron, proton or atomic nucleus is practically undetermined. To know the instantaneous field of such a fundamental particle of matter to within one part in a hundred, Professor Lemaitre computes that its charge must be at least 60,000,000 (sixty million or 6 times 10^7) times the fundamental charge on the electron which physicists designate as small letter e. This is a relatively large quantity although it is small when translated into volts.

The atom as originally visualized by Professor Neils Bohr, the Danish physicist, was considered by Professor Lemaitre in the light of these new computations of the uncertainty principle.

"Bohr was right," Professor Lemaitre said, "when he considered the field of the atomic nucleus as determining the orbit of the electron, since this field is static and remains significant when averages are taken over long periods of time. He was also right in neglecting the radiation of the moving electron, because we see now from the uncertainty principle that the only determined field is the average field during a time in which the electron has made more than 10,000,000,000 (ten billion or 10^{10}) revolutions."

FEDERAL "ECONOMY" AND MINE RESCUE WORK

THE nation's "mine rescue squads" and the preventive and research work that protects 1,700,000 men and $14,000,000,000 of capital in the country's mining industry are threatened with the Congressional economy ax.

If recommended federal appropriation cuts urged by the House Committee are made, the U. S. Bureau of Mines of the Department of Commerce will have $127,000 less in funds to support the mine rescue cars, train miners in rescue and safety, operate an experimental mine and perform research on equipment and method to aid the states in preventing mine disasters.

At the present time $741,000 is provided for this work. This is only one two-hundredth of one per cent. of the nation's investment in the mining industry—an infinitesimal price to pay for protection. The budget pared the recommended funds for 1933–34 to $664,000 and now the House bill proposes only $614,000.

The eventual abolition of this fundamental research and service to the mining industry is threatened by the House Committee report just made. The committee reported its opinion that the investigations had been unavailing in many instances because the states have not made public nor acted upon the findings of the bureau. Unless the states secure improved conditions in the

mines, the committee does not favor continuance of the federal work. Evidently viewing the task of making mines safe as a static one, the committee then said, in effect, that if the mines are made safer, the rescue and safety work can be abolished.

During the past fiscal year, the Bureau of Mines aided mines and states in connection with 33 explosions in which 87 persons were killed and 59 injured; with 21 fires which took one human life, and with 40 miscellaneous accidents which claimed a toll of 58 persons killed and 156 injured.

The mine rescue cars of the Bureau of Mines have acted as the "Rescue Squads" of the mining industry. Ten such cars have been maintained, equipped and ready to speed at an instant's notice to the rescue of trapped victims of a mine disaster. They have been kept at strategic points throughout the mining territory of the country. When not needed for emergency work they were kept in constant use, traveling continuously from mine to mine giving instruction and exhibitions of first-aid and mine rescue methods. In the event of a mine disaster, the nearest car drops its training at once and proceeds to the scene of the accident, where the crew gives its valuable trained assistance in rescue and recovery operations.

Reduction of funds last year made necessary the withdrawal from service of four of these ten rescue cars. This year's slash in funds will require the withdrawal of more cars and, what is more vital in the long run, about half the curtailment will be from research.

RECLAIMING RIVER-BOTTOM LANDS

PRESIDENT-ELECT ROOSEVELT'S project for reclaiming river-bottom lands for agriculture, while marginal upland farms are returned to forest, is in a sense a return to the world's earliest recorded planned farming systems, those of Egypt and Babylonia. For in both these ancient lands the river bottoms were farmed and the uplands let alone.

In Egypt this was necessarily the case, for the uplands were deserts. But even if there had been hill lands available, they probably would have been neglected in favor of the richer lands nearer the river.

River bottom lands the world over are usually more fertile than the adjacent uplands. This is as true in the Tennessee Valley as it is in the lands of the Nile and the Euphrates and Tigris, and for the same reasons. The recurrent floods of rivers carry down the best surface soil from the uplands nearer the head of the river, as well as decayed plant and animal remains from the forests, and spread it over the inundated lowlands. In time, thick deposits of easily worked, exceedingly rich alluvial soil are formed.

It was on this alluvial land, collected as a geological tribute from vast uninhabited territories in Africa and Asian highlands, that the world's first farming civilizations rose. And it is to such a neglected wealth of river-bottom land, which now contains much of the fertility that a century of rains have washed down from the hillside farms and denuded forest areas, that President-elect Roosevelt hopes to see poor hill farmers and possibly landless men from cities transplanted.

In Egypt the annual inundations of the Nile were an almost unmixed blessing; the only great misfortune that could visit the land was that the flood might not rise high enough. In Babylonia floods were sometimes disastrous, but the twin rivers of that land were usually controlled by mighty engineering works and a network of distributing canals for irrigation. In the Tennessee Valley, and in the other lowlands to which Roosevelt's ultimate vision extends, floods will be no blessing and must be kept under control by diking, by impounding flood waters in power reservoirs, and by holding headwater streams to a more even flow by means of new forests on the hills.

THE ALUMINUM AGE

THE exhaustion of iron and steel of the present age of metals forebodes no evil for civilizations-to-come, in the picture of the future given the American Institute of Electrical Engineers at a recent meeting by Professor Colin G. Fink, of Columbia University, inventor and authority on electrochemistry.

For the next age will be that of aluminum, Professor Fink predicted. And aluminum is the most abundant common metal in the earth's crust, being even more common than much-used iron, which it is expected to supplant for many purposes.

"The keynote of the coming new era will be the large number of new products and devices," according to Professor Fink. "Among the metals the one metal to enter the widest variety of new fields will be aluminum —aluminum for railway equipment, aluminum for roofs and buildings, for food containers, for transmission, for airplanes, for tank cars, pipe lines, fencing, etc. Finally we should mention the new aluminum plate, superior to tin plate in many respects, developed at the electrochemical laboratories at Columbia.

"Whereas the supply of raw material for many of our metals is comparatively limited in years, the supply of bauxite or aluminum ore is almost limitless. Thus, for example, whereas copper at the 1929 rate of consumption will last but forty or fifty years, the aluminum ore reserves will satisfy our demands for many hundred years."

In the relative abundance of the common metals in the earth's crust, taking the parts by weight, aluminum leads with 80,000, iron is second with 50,000, while copper is seventh with only twenty. For every pound of copper in the earth's crust there are 4,000 pounds of aluminum.

VITAMIN B_2 AND PERNICIOUS ANEMIA

ONE cause of pernicious anemia may be lack of vitamin B_2 in the diet, Dr. William B. Castle, of the Thorndike Memorial Laboratory, Boston City Hospital, and the Harvard Medical School, reported to the American College of Physicians meeting in Montreal. His studies also suggest a new idea of the relation between certain vitamins and the conditions caused by their lack.

Dr. Castle received the John Phillips Memorial Prize of the college. Associated with him in the anemia research were Drs. Wilmot C. Townsend, Clark W. Heath and Maurice B. Strauss, of the Thorndike Memorial Laboratory, and Dr. C. P. Rhoads, of the Rockefeller Hospital.

Liver may be a means of curing pernicious anemia, but lack of liver in the diet is not the cause of the disease. Pernicious anemia develops in those people whose stomachs can not make their own supply of liver extract from a normal diet. When vitamin B_2 is fed to a normal human being, his stomach makes it into something that acts like liver extract because of a reaction with what Dr. Castle calls the intrinsic factor in the stomach juice. It is chiefly lack of this intrinsic factor which causes the usual cases of pernicious anemia and also some of those occurring in mothers before the birth of a child. After the child is born, however, the intrinsic factor reappears to a certain extent, as it did in one exceptional case of pernicious anemia following liver treatment.

Vitamin B_2 is found in meat, milk, eggs, the outer layer of rice, and yeast. It is lack of this factor in the diet which produces the type of pernicious anemia found in the tropical disease, sprue, and in celiac disease, an intestinal ailment of children. The vitamin factor in the cause of pernicious anemia Dr. Castle calls the extrinsic factor.

A third important factor in the development of this disease is what Dr. Castle calls "defects of absorption." Even if the vitamin is eaten in abundance and the intrinsic factor is present in the stomach juices, the body may fail to absorb the product formed by the interaction of these two factors. This is seen in certain cases of pernicious anemia or sprue in which enormous doses of liver extract have little effect when given by mouth, whereas the usual dose given by hypodermic produces a typical response.

Dr. Castle's researches have thus shown that there are three ways in which the formerly fatal disease, pernicious anemia, may be caused. It is a deficiency disease in a novel sense, since the deficiency is not so much a lack of vitamins in the diet as the failure of a reaction with a vitamin in the digestive tract or elsewhere in the body.

ITEMS

A NEW compact electrical impulse generator hurling 3,000,000 volts is reported to *Nature*, from the Metropolitan Vickers Laboratory, Manchester. The new high voltage machine is only five feet in diameter and ten feet high. It contains parallel charged, oil impregnated condensers with all spark gaps segregated in an air column with the air under high pressure. It thus combines the advantages of both air and oil gaps. The engineers who constructed the new generator were: T. E. Allibone, F. S. Edwards and D. B. MacKenzie.

THAT all neutrons do not have the same mass or weight is predicted by Dr. A. v. Grosse, of the Kent Chemical Laboratory, University of Chicago, in a communication to *The Physical Review*. Electrons, or beta rays, given off from a disintegrating atomic heart, do not always have the same energies. This has worried physicists so much that some have suggested that the principle of conservation of energy be abandoned in considering the emission or capture of electrons in the atomic nucleus. Dr. Grosse suggests instead that the masses of all neutrons are not identical, but vary according to the energies of the beta rays that are actually observed. The neutron was the atomic building block, similar to the proton or hydrogen atom heart except for its electrical neutrality, which was discovered by Dr. J. Chadwick, at Cambridge, England, last year.

LITHIUM atoms have been disintegrated by bombardment with streams of protons or positive electrical particles at relatively low voltage, by three German physicists at the Institute for Experimental Physics at Kiel, Drs. H. Rausch von Traubenberg, A. Eckardt and R. Gebauer. They sought the threshold, or point of lowest electrical energy, at which the atom-breaking phenomenon would take place. When first performed last year by Drs. J. D. Cockcroft and E. T. S. Walton at Cambridge University, the energy used amounted to 600,000 volts. With a specially constructed apparatus the workers at Kiel obtained definitely detectable atomic breakdowns with an input of only 29,000 volts, less than a twentieth of the energy used in the English experiments. The work is summarized in a report to *Die Naturwissenschaften*.

ENOUGH iodine to supply the entire present American market could be produced at the end of a year's expansion program of a new chemical plant recently established at Los Angeles to extract this widely used element from California oil-well brines. Its present production is several hundred pounds of iodine a day, but it can be expanded to produce 350 tons a year, the present American consumption, if this should prove necessary. The plant has already wrecked the monopoly price formerly maintained by the Chilean nitrate corporation, which obtained iodine as a by-product of its fertilizer production. Some months ago the Chilean corporation cut its former price of $4 a pound to $3; within the past few weeks a further cut was made to the present prevailing price of $1.95 a pound. The new American firm has met all its rival's price cuts, and it is reported they are able to face any price competition which Chilean iodine may offer.

VIGILANT sentinels of science on all the borders of the United States stopped over twelve thousand invasions of American territory by insect pests and fungus diseases of plants in a single year. A detailed report of the period covered—July 1, 1931, to June 30, 1932—has been published by the U. S. Department of Agriculture. At least eight distinct species of fruit flies were stopped, as stowaways on a long list of fruits and vegetables from an even longer list of foreign ports. Most prominent among them was the Mediterranean fruit fly, whose outbreak a few years ago in Florida caused a serious situation and was suppressed only with much labor and expense. This world-distributed pest was detected on fruits from Algeria, France, the Azores, Bermuda, Hawaii, Italy, Spain and Venezuela.