



DR. P. A. M. DIRAC

Material Objects Seen As Holes in Space By British Scientist

Physics

A NEW idea of the constitution of space was presented science when Dr. P. A. M. Dirac, twenty-five year old Cambridge physicist already famous in mathematical circles, announced to the British Association for the Advancement of Science at its recent meeting in Bristol his new theory that there is everywhere an infinite density of negative energy electrons.

Gone is the idea that there is absolutely nothing in a perfect vacuum, for Dr. Dirac said: "A perfect vacuum is now to be considered as a region of space in which all the states of negative energy and none of those of positive energy are occupied."

Everything that is material to us, all the material things of the universe, are made up of "holes" in this vast space sea of negative energy, according to Dr. Dirac's theory. In other words, things that actually exist and can be experimented with have positive energy and can be considered to be vacant places in the space of minus or negative energy. In a way, this is a modern substitute for the other.

Defines Proton

Dr. Dirac told the physicists what they have long wished to know, just what is the nucleus of the hydrogen atom, better known as the proton. He said: "It will be a sort of hole in the distribution of negative energy electrons. To make the hole disappear which we can do by filling it up with an electron of negative energy, we must put into it a negative amount of energy. This means that the hole itself will have a positive energy. It

now appears reasonable to interpret this hole as a proton."

The importance of this conception is evident from the fact that science now conceives of all chemical elements being made up of protons and electrons, the simplest of elements being hydrogen consisting of one proton and one electron.

"There are theoretical reasons for believing in a connection between the two kinds of particles, electrons and protons," Dr. Dirac explained. "They are not independent and there is ultimately only one kind of fundamental particle in nature. This connection is in fact rather forced upon us by general considerations about the symmetry between positive and negative charge which prevents us from building up a theory of negatively charged electrons without bringing in also the positively charged protons."

Electron Annihilation

The ordinary electron of positive charge is the fundamental unit of electricity and plays a vital role in every electrical device such as a radio tube. When a hole in Dirac's space of negative energy electrons is filled there must be the disappearance of an ordinary electron.

"This disappearance of a hole would thus be interpreted," Dr. Dirac stated, "as an electron and a proton annihilating one another, their energy being emitted in the form of electromagnetic radiation. There appears to be no reason why such processes should not actually occur somewhere in the world. They would be consistent with all the general laws of nature, in particular with the law of conservation of electric charge. The frequency of occurrence of such processes must, however, be very small under ordinary

conditions as those processes have never been observed in the laboratory."

World Hunger and Science

Hunger ever threatening the overpopulated world like a spectre and ever pushed back by the hand of science was the center of the dramatic picture drawn by Prof. F. C. Bower, president of the Association, at the opening of its meeting.

He quoted the prophecy of Sir William Crookes made upon the occasion of the British Association's last Bristol meeting in 1898. This eminent scientist then predicted: "Wheat cannot long retain its dominant position among the foodstuffs of the civilized world. Should all the wheat growing countries add to their area to the utmost capacity, on the most careful calculation the yield would give us only just enough to supply the increase of population among the bread-eaters till the year 1931. The details of the impending catastrophe no one can predict, but its general direction is obvious enough."

But Sir William speaking in 1898 added the comforting prediction that the future would take care of itself because with the artificial production of nitrates the yield of wheat per acre would increase.

"We who are living within a few months of the fateful year of 1931 are unaware of any wheat shortage," Prof. Bower commented. "Sir William Crookes' forecast of 1898 as to the advance in the production of combined nitrogen has been fully realized. Artificial fertilizers are not in view only, but at hand and in mass. Moreover the northern limit of successful wheat culture has been greatly extended by the production of

new strains with ever shortening period between sowing and reaping while the establishment of new varieties is extending the productive area into regions where the rainfall is of short duration and restricted in amount.

"What better example than this could we desire, not only of the importance of applied botany, but as showing also how its advance follows on research independently pursued. For the production of synthetic nitrogen, which has now become a commercial proposition, and the improvement of the strains of wheat by selective breeding along Mendelian lines, are both involved in this crucial question of food supply. And both owe their origin to advance in pure science."

Origin of Tobacco

To millions of smokers throughout the world who puff allegiance to tobacco, Prof. T. H. Goodspeed, American botanist at the University of California, brought news. He announced that he has discovered the origin of tobacco.

The tobacco of commerce is a natural hybrid of two other closely

related species that grow wild. Prof. Goodspeed arrived at this conclusion as a result of breeding experiments upon wild tobaccos. He produced a hybrid tobacco that resembles the commercial tobacco externally and in cellular details and he therefore concludes that nature by a similar process many years ago accomplished the same hybridization.

Next of Kin

The chimpanzee was declared to be man's nearest living relative in the course of a discussion by Dr. C. Tate Regan, director of the Natural History Museum of South Kensington, London, who outlined for the British Association the evolution of the primates, among them man.

But the chimpanzee is not in man's direct ancestral line, Dr. Regan made clear. Some anthropologists have heretofore concluded that the gorilla is man's nearest living cousin.

Dr. Regan expressed disagreement with the head of another great natural history museum across the Atlantic, Dr. Henry Fairfield Osborn, president of the American Museum of Natural History of New York City. He attacked Dr. Osborn's view

on man's ancestry. Dr. Osborn at the meeting of the American Association for the Advancement of Science last winter surprised his colleagues by contending that the human race has existed as a distinct natural division, wholly separate from its nearest relatives, the great apes, for more than a million years. This made man much older than other anthropologists were willing to concede. Now Dr. Regan reaffirms the more general view that man, while not directly descended from the great apes, is an offshoot from a common stock that divided at a more recent geological period than Dr. Osborn would agree to.

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Bold Invasion

THE root bacteria of clover, alfalfa and other legumes, that befriend the plants and through them man and his domestic animals, come at the outset as though they were enemies. They invade the delicate, thin-walled root-hairs in just about the same way as disease germs, and cause them to curl up as though they were sick. These are among the things that were seen by an international research team, consisting of Dr. H. G. Thornton of the Rothamsted Experimental Station, England, and Dr. E. F. McCoy of the University of Wisconsin, and described by them before the International Botanical Congress at Cambridge.

Not all the roots of a susceptible plant can be invaded by the bacteria, the two investigators found. Alfalfa seedlings were suspended with their roots in a thick "soup" of nodule bacteria; yet only about four per cent. of the root-hairs received bacterial guests.

Moreover, the plants seemed to have a considerable degree of resistance to such invasion during their infancy, for no bacteria found their way through the walls of the root-hairs until the seedlings had put forth their first true leaves. This would seem to indicate that a secretion of the roots was active, either in discouraging the bacteria before the leaves appeared, or in encouraging them when the proper time arrived.

Botany

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Gentile and Jewish Blood Unlike

Ethnology

A STRIKING difference between Gentile and Jewish blood when tested with various chemicals was discovered recently by a Russian biologist, Dr. E. O. Manoilloff, creating considerable stir among biologists and anthropologists.

Dr. Manoilloff worked on Jews and Gentile Russians. He added to a blood clot a goodly amount of salt solution and a few drops of a dye-stuff, called cresyl-violet. In Jewish blood the color of the cresyl-violet disappeared entirely or almost so, and a bluish or greenish tinge alone remained, while in the Gentile Russian blood the cresyl-violet remained partly insoluble and appeared blue-red. The Jewish blood oxidized the dye more readily than the Russian.

Dr. Manoilloff requested several investigators to send him samples of Jewish and Russian blood marked only with numbers, the identity of the samples being known only to the sender. He tested 202 samples and gave the correct answer in 187 cases, that is 91.7 per cent.

Madame Poliakowa working in the

State Institute of the Public Health Commissariat at Leningrad, applied Manoilloff's race-test to the determination of paternity. In cases of pure marriages where father and mother belonged to the same nationality the child's blood reaction corresponded to that of the parents. In mixed marriages the color of the child's blood resembled either the father's or the mother's. Mixed marriages between Russians on the one hand, Germans, Poles and Finns on the other, made the child's blood look Russian, whereas a match between a Russian and a Jew resulted in Jewish blooded babies.

She concluded that in racially pure marriages the child's blood has the same reaction as the father's and mother's; that if the child's and mother's blood give a different reaction, the father does not belong to the mother's nationality; and finally that if the child has a distinct race reaction which does not correspond to the mother's nationality, the father may belong to the nationality, the reaction of which has been found in the child.

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The Roman orator Cicero was aided in his work by a secretary who worked out a shorthand system and took down Cicero's speeches.