PHYSICS

Advance Theory of Matter

➤ MATHEMATICAL gymnastics of a 30-year-old Harvard physicist, who drew murmurs of appreciation and awe from an audience of leading scientists, may help explain the nature and structure of matter.

Dr. Julian Schwinger of Harvard performed the mathematical feats at a session of the American Physical Society meeting at the California Institute of Technology. He said that his new method helps weed out deviations in present theory. Still unsolved, he emphasized, is the comprehensive answer to many problems of physics which will require a unified "field" theory explaining both waves and particles.

Twin horns of the modern dilemma in physics are two theories upon which scientists have for many years based their concepts of electrons and electromagnetic waves. One theory, named after the modern English physicist, Dr. P. A. M. Dirac, satisfactorily explained the behavior of electrons as charged particles, or fixed points. The other theory by the nineteenth century British physicist, Clerk Maxwell, explained the behavior of electromagnetic waves of all kinds, including such waves as light and radio. The theories are valid singly, and satisfactorily account for two separate physical phenomena. Scientists used one set of rules to explain the behavior of electrons as particles, and another to explain waves.

When the electron as a charged particle is placed in an electromagnetic field, however, the Dirac theory of the electron as a fixed point breaks down. Until very recently, this inadequacy remained a bridge with no necessity of being crossed. Recent experiments by Dr. I. I. Rabi of Columbia University, under whom Dr. Schwinger once studied, and others, however, blew the bridge sky high. Employing new and improved methods of studying electron dynamics, Dr. Rabi, a Nobel prize winner, showed the deficiencies in the theory so that they could no longer be ignored.

With extremely precise measurements he specifically pinpointed the deviations in Dirac's theory and pointed up the whole problem.

With an appreciable body of scientific knowledge hanging in the balance, Dr. Schwinger came to the rescue with a mathematical method of accounting for the deviations. By slightly modifying the Dirac theory, he salvaged a workable portion of the original idea and effected a compromise if not a wedding between Rabi's new findings and the old theory.

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ENGINEERING

Unmined Coal Yields Gas

➤ A SECOND experiment is underway in Gorgas, Ala., following that of last summer, to produce combustible gases by burning unmined coal deep underground as it lies in its natural seams. A contract to carry out the work has been made by the U. S. Bureau of Mines and the Alabama Power Company, the team that carried out the first experiment a year ago.

Basically, the plan followed consists of drilling from the surface down through the layer of coal. Fire is started by dropping an incendiary bomb down a hole. Air, under considerable pressure, is forced down the same hole to feed the fire and to force the combustible gases formed by the burning through the coal layer to one or more of the other drillings. The gases arising to the surface are captured and piped to storage tanks. They can be used to fire a boiler or used to make synthetic liquid fuels.

The experiment last summer showed that gases produced by burning unmined coal offer a potential source of fuel for power and raw materials for synthetic liquid fuels. If the plan proves commercially feasible, much coal can be utilized that is in layers too thin for economical mining. The gas obtained is a cheap source of carbon monoxide and hydrogen, the number one problem in making the manufacture of synthetic liquid fuels economical.

Last year's experiment showed that the underground combustion can be maintained and controlled, that coal in place can be gasified completely, and that the roof rock settles behind the burning face without cutting off the air or gas. But the gas obtained was of lower heating value than desired, probably because of leakages of gas and air pressure through cracks and breaks in the 30-foot layer of earth over the burning coal.

This year a 40-inch seam approximately 100 feet below the surface is to be used. Higher air pressure and higher temperature will be employed. Oxygen and steam can improve the gas quality further, as was proven last year.

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ENGINEERING

Flood Control in Mines Studied by Government

➤ FLOOD-CONTROL measures, an underground type little known but important in mining, are again to be studied this year in the anthracite coal region by the U. S. Bureau of Mines. A federal appropriation of nearly $300,000 is now available.

Mine-water problems of the hard coal fields are of long standing but are growing worse. The average anthracite mine now pumps out about 13 tons of water for every ton of coal removed. Twenty-five years ago the ratio of water pumped to anthracite extracted was eight to one. The bureau has conducted scientific and technologic investigations to assist operators in solving this water problem since 1944.

Billions of tons of anthracite are inundated by underground water pools in the anthracite region. These pools must be emptied before mines can be worked. Even those in worked-out mines are a hazard to neighboring excavations. The so-called barrier pillars left unmined along property lines or lines of adjacent mining operations may be a hazard. They operate normally as dams to prevent water in one mine from suddenly breaking into another, with subsequent loss of life or property. Proper pillars are a part of the study of the Bureau.

Present investigations are concerned with means for reducing the infiltration of surface and other water into the mines as well as with barrier pillars, pumping methods and the proper disposal of the pumped water so that it will not seep back into the same or into other mines. One of the factors retarding flood-control projects embracing the entire anthracite region is an estimated $100,000,000 cost.

Eleven counties in eastern and northeastern Pennsylvania produce 95% of the anthracite in the United States. Approximately 80% of the production is consumed in the New England States, New York, New Jersey, Maryland and the District of Columbia. Some 40,000,000 persons are now dependent on hard coal for residential heating. About 1,250,000 persons depend, directly or indirectly, upon the anthracite industry for a living.

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ENGINEERING

Steam Blast Melts TNT Out of Its Steel Shell

➤ STATESMEN may be a bit slow about beating swords into plowshares, but a civilian employee of the Army, Cedric A. Hoskin of Succasunna, N. J., has devised an improved method for getting TNT, PETN or other high explosive charges out of shells, for possible use as blasting powder.

It consists simply of a grid of steam pipes, each one with a row of discharge-vents over which the opened shells are set. The steam blast melts out the high explosive, which trickles into a sloping-bottomed tank below, kept full of cold water. The trickling, tar-like explosive forms into firm pellets, which are raked out through an opening at the lowest part of the bottom, dried, and prepared for other uses. The empty shells, of course, are high-grade steel scrap.

Rights in the patent, No. 2,444,045, have been assigned royalty-free to the government.

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